Mr Bowman

The Foundry Trade Journal. AND THE IRON AND STEEL RECORD.

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CONTENTS:

	PAGE
BRITISH FOUNDRYMEN'S ASSOCIATION	1
PORTRAITS OF PIONEERS— VII.—WILLIAM MENELAUS	3
LABOUR-SAVING SUGGESTIONS	4
MOULDING MACHINES AND THEIR USE	6
THE NEED OF STANDARD SPECIFICATIONS FOR GRAY IRON CASTINGS	11
SCRAP-IRON SPECIFICATIONS	23
PIG-IRON WARRANT SYSTEM AND THE FOUNDRY	32

Correspondence. Queries. Among the Foundries. Notes. Metal Chart.

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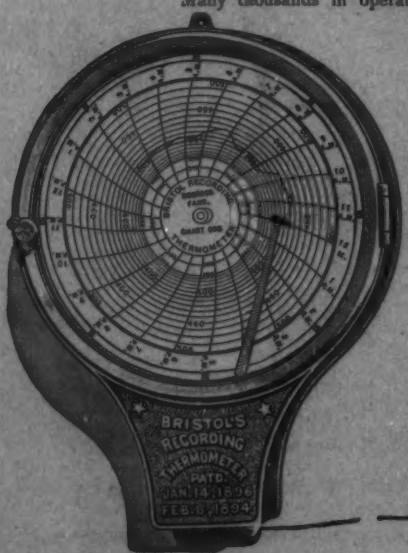

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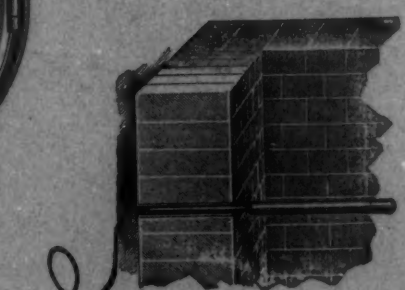

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AND

The IRON and STEEL RECORD.

Vol. 6. **JULY 18, 1904.** **No. 31.**

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BRITISH FOUNDRYMEN'S ASSOCIATION.

WE print below a copy of a circular letter, issued by the above, which should make glad the hearts of all British foundrymen. It proves that the Association, although founded but a few months, has met with such success that it is strong enough to hold its first Convention at the beginning of next month.

We trust that the Convention will be well supported. If any foundryman has not received an invitation and would like to attend, he should at once write the Secretary.

Kingston House, Lansdown Road,
Gloucester, *July*, 1904.

DEAR SIR,—By kind permission of Principal Hopkinson and the Council, the first Annual Convention of the Members of the British Foundrymen's Association will be held in the Chemical Lecture Theatre at Owen's College, Manchester, commencing Tuesday, August 2nd, 1904.

At 10 A.M. a Business Meeting will be held for the Election of Officers for the ensuing year, and to fix place of meeting for next Convention. At 11 A.M. the Presidential Address will be delivered. After an interval for lunch, the Convention will resume at 3 P.M., when papers will be read by eminent members of the Foundry trade. In the evening a Smoking Concert will be held.

On Wednesday, August 3rd, a visit will be made to the Westinghouse Works, Trafford Park, which have been kindly

opened to us by the managers. Should time permit, other works will also be visited.

A detailed Programme will follow in a few days.

The Committee hope to have the pleasure of your company at the first Convention of its kind ever held in this country.

Yours truly,
F. W. FINCH,
Hon. Secretary.

Correspondence.

PRESSURE IN MOULDS.

To the Editor of THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—I have little to say in reply to Mr. W. R.'s most unsatisfactory letter in your last issue.

I had noticed W. R.'s errors in calculation, but as the matter at issue was not affected in the least by them they were allowed to pass without comment.

The reason I referred to Archimedes, "an engineer of great antiquity," was because he is the reputed discoverer of the peculiar property of fluids I have spoken of as "the universal communication of pressure."

I have seen the inside of the foundry walls, a time or two at least, and although of a very observant disposition have failed up to now to discover anything which leads me to suspect that Archimedes was at fault. I believe also that the whole of our *modern* philosophers, too, are *entirely at one* on this particular point; but, perhaps, after all, they are all mistaken, and "W. R." correct. The minority are, I believe, very often proved, after all, to be in the right; or, maybe, fluid metal has an entirely different action "in the foundry," as against "in the laboratory."

Because Mr. West has been wise enough to see the error (?) of his ways in respect of ·25, it is quite possible, of course, that early in the future he may similarly own to a change of opinion in the matter in dispute—buoyancy.

True, "professors" from the beginning have agreed to differ, but only in cases where the foundation built upon was unstable; but whoever heard of mathematician differing as to the result of the addition of two to two!

If "W. R." will set himself the task of getting to the bottom of the subject in dispute, entirely laying aside prejudice or bias, he *must* arrive at a belief in "universal communication," and then his own structure—its very foundations undermined by the change in belief—*must* come tumbling to the ground.

So far as the writer is concerned, this letter will close the subject.—In good humour still, I remain, etc.

FRANCIS W. SHAW.

QUERIES.

This department of the JOURNAL *undertakes the answering of queries in the following branches:* Blast Furnace Practice, Basic (steel making) Processes, Cast-iron, Malleable Cast-iron, Steel, Brass, Bronze, &c., *by eminent authorities in each branch. When necessary, the aid of chemical analyses, mechanical testings, micrographic, or microscopic examinations will be invoked.*

The queries will appear repeatedly till answered. No charge is made to readers for answers, except where chemical, mechanical, or micrographic analyses are necessary, in which case the actual fee paid by us will be charged.

There are many other queries outside the scope above referred to which reach us at various times which we trust our readers will afford us assistance in answering.

Communications should be addressed to the "Editor, THE FOUNDRY TRADE JOURNAL, 104, Great Russell Street, London, W.C.," *and marked outside* "QUERIES," *and must be accompanied by the correct name and address of the querist, not for publication, but as a guarantee of good faith, which will be treated, with strict confidence.*

Blackings.—Will any of your numerous readers kindly give their experience with regard to Blackings.

We are having some trouble in our

Foundry in this respect. Our castings do not come out at all clean; sometimes we have to chip the facing off, then the casting has the appearance of having been moulded in loam without any Blacking on. We shall be indebted to your valuable journal and to any practical foundryman who will kindly give us a hint in this direction.—I remain, yours truly,

LOAM-MOULDER.

Brass Liner. — Being an interested party in this job, and as failure to get a good casting occurred two or three times, I have thought, by bringing it before your readers, there might be information forthcoming for all concerned in this class of work.

Not being a brass moulder myself, I can only deal with the surface of things, and hope for a bit of give and take from all who may feel inclined to do so, and from what has been already given by your practical readers, I think your journal has improved by throwing its pages open for the discussion of practical questions such as "bad castings" or anything that is of interest in either shop or Foundry connected with the trade.

The casting in question when polished was more or less speckled with small black holes, say, in size from a pin point to about three-sixteenths of an inch, and of irregular dimensions which became aggravated by grouping themselves in several places from top to bottom in zig-zag fashion—this, of course, condemned the casting.

Some blamed it on the mixture of metal, others blamed it on the coke, and, as might be expected, the core and cope had their share of attention also.

All agreed that it was dirt, but as to where it came from remains as yet a puzzle.

If any of your readers would give us their opinion so as to assist us in future I shall feel obliged, and thus enable us to produce our work as near as possible with a first cast in this the age of keen competition. Wishing the journal the success it so richly deserves, I enclose my card and remain, yours very truly,

30th March, 1904. SUBSCRIBER.

Cupola Charges.—I have read a great deal in your paper about successful working of cupolas. I have been trying for some time to get the best results of ratio of iron to fuel for light castings; at the present time we are melting 10 ton × 8 cwt. to 10 ton × 12 cwt. per day to 17 cwt. of coke, ratio about 12 × 1, I believe; of course, this includes bed as well, which is 6½ cwt. I should be glad to know of anyone who has had better results.

FOREMAN MOULDER.

PORTRAITS OF PIONEERS.

VII.—WILLIAM MENELAUS.

MR. WILLIAM MENELAUS, who occupied a prominent position in the iron and steel trades during one of its most eventful opochs, was born in East Lothian on March 10th, 1818, and, after receiving at a local school a sound education, he was apprenticed to a Haddington firm of engineers. His apprenticeship completed, he was for a short time in London, and then went to Middlesbrough, where he erected and worked brickmaking plant. Afterwards, while engaged by an agricultural machinery company, his conspicuous ability attracted the attention of one of the leading Welsh ironmasters — Rowland Fothergill — on whose estate he was superintending some work, and he was offered the post of assistant engineer at the Abernant Iron Works, Aberdare. He accepted, and in a short time rose to the position of chief engineer—which he held for seven years.

In 1851 he became engineer to the Dowlais Iron Co., and was soon entrusted with the responsibility of managing their

forges and mills. Fourteen years later he was appointed general manager, and continued in that highly honourable and responsible position for seventeen years.

Those thirty-one years with the Dowlais Company were most eventful for the trade. They witnessed the introduction of systematic scientific investigation in iron and steel works, and the triumph of modern methods of smelting, purifying, alloying and handling large masses of metals. There was a strong desire to

Mr. William Menelaus.

improve the method of puddling, and Menelaus strove to win success by mechanical contrivances. But the advent of the Bessemer process turned the attention of thoughtful managers in another direction, and, when that brilliant process emerged from the clouds which had for a time obscured it, one of the first works in which it was installed was Dowlais, for Menelaus had promptly taken it up in the early days and never lost faith in it.

Being a firm believer in the future of mild steel, he early established in Dowlais not only the Bessemer, but also the Siemens' process. There, on what has been described as "a rough mountain-top, a thousand feet above the level of the sea," the struggle for supremacy between puddled iron, pneumatic steel, and open-hearth steel was waged, and all three processes were carried on. The open-hearth (Siemens') plant laid down in Dowlais by Menelaus was amongst the first for conducting the process on a large scale.

In the working of mild steel he took a foremost place, and he devised important improvements in the rolling of rails.

He was one of the founders of the Iron and Steel Institute; a founder and the first president of the South Wales Institute of Engineers, and a vice-president of the Institution of Mechanical Engineers. In 1875 he was elected president of the Iron and Steel Institute, and in 1881 was awarded the Bessemer medal.

Menelaus died on March 30th, 1882. He won for himself a high reputation and enjoyed the esteem of all grades.

Walter Macfarlane, F.I.C.

LABOUR-SAVING SUGGESTIONS FOR THE FOUNDRY.*

By H. F. Frohman, Cincinnati.

MANY articles have been written on labour-saving devices, and important facts brought out by able writers, but I desire to put the question before the foundrymen from the standpoint of the practical Foundry supply man, who has had many years' experience, and has visited probably almost all the leading Foundries of this country.

I will not dwell on the necessity of having good equipment, such as suitable cranes, designed and constructed for the class of work they are to do, an up-to-date, economical melting cupola, with all the proper appurtenances; nor on a battery of exhaust tumbling mills for

* Read at the Indianapolis meeting of the American Foundrymen's Association, June, 1904.

cleaning castings; nor on the methods for distributing iron; but will dwell on the minor articles, such as are usually overlooked in the large shop.

I readily appreciate the fact that many foundrymen will say we have all the foregoing, and why should we not produce our castings at the minimum cost? Yet there are many small labour-saving devices that can be introduced, which, used in connection with the more important equipment, and with good management, should make the Foundry business a successful one.

While Foundry supply men are considered a nuisance by some, to others, we are happy to say, they are heartily welcome. The Foundry supply man is brought in contact with the foreman and moulders, and an exchange of ideas has resulted in many a simple and successful device being put on the market to the benefit of all concerned.

While the writer was visiting a certain Foundry he noticed a moulder using a perforated piece of tin to hold up the core in the mould. The idea seemed to be excellent, and the explanation of the moulder that the tin being perforated allowed the iron to alloy with it more thoroughly than would otherwise be the case seemed conclusive. The suggestion was taken up, and now perforated tin chaplets are on the market in all sizes that are required. Foundries making very thin castings have found them exceedingly serviceable; in fact, they would not do without them if they could help it.

Another simple thing is a core coating. This is used on a steel core, where a number of these may be used in one casting. The method is to dip the steel core into the coating, set it into the mould, and the iron will flow freely around it, making a perfect hole with neither a chill nor a blow.

A mould-drying apparatus. This is a device for doing away with burning charcoal in a dry sand mould. It is used with a direct flame from a torch, in connection with compressed air, the result being more economical and satisfactory than the old style.

My attention was also called to the chiselling out of follow boards and match parts, and after much study and experiment with the assistance of the shop and the laboratory, a compound was gotten up which can be poured into a temporary mould, using the original pattern, and a satisfactory match made at one-tenth the cost of the old method. After setting, this match becomes almost as hard and as true as the iron itself, and makes an excellent follow board or sand match, which becomes better as it gets older, and retains perfect parting.

In many Foundries where dry sand moulds are made, it seemed a hard problem to put a liquid blacking on the moulds evenly and well distributed. It seems that when this blacking is prepared for use, and allowed to stand for a few minutes, the blacking settles at the bottom. This trouble is now obviated by using a compressed air blacking swab. This swab mixes and distributes the blacking very evenly over the surface of the mould, and can reach any part inaccessible to the hand. For this reason the result is much more perfect, and the castings brighter, cleaner, and better in every way.

I might also mention the various designs of sandsifters used in a Foundry. By adopting these machines many a dollar has been saved. There are now machines on the market which can riddle as much sand in one hour as formerly required the labour of two men for a whole day. It is also said that these machines temper the sand much more thoroughly. Facing sand may be prepared by them, and their use in the core-room is also highly advantageous for mixing sand with the various compounds, flour, or rosin.

I remember, years ago, there was a certain Foundry in Ohio where they employed girls to make the cores. Should a stray salesman happen to wander in to

see the foreman, these girls would spy him, and take all the conceit out of him that he ever possessed. I happened to be in that Foundry again a few years later, dreading to approach that core-room, but to my agreeable surprise found the young ladies wanting, and instead two boys operating two machines for making cores which formerly were made by not less than twenty-five persons. The machines were constantly fed, and as fast as the wheel could turn made satisfactory cores, true and round, and well vented—in fact, faster than the moulders could use them.

Many other simple labour - saving devices could be enumerated as having come under my notice, and all of them would not only become sources of economy, but also result in considerable profit to the foundry-man.

MOULDING MACHINES AND THEIR USE.*

By E. H. Mumford, Philadelphia.

IT is not my purpose to describe or to advocate any particular moulding machine to the exclusion of others. There is use for all. If there is any trade under the sun to which it is impossible to adapt one single machine or one mechanical process, it is that of moulding for metal castings, from patterns as chaotic in outline and dimension as are the brains that originate them, in the one material of the universe which, from Scriptural times on, has been the symbol of instability and fickleness. When the moulding machine art shall at length be finally and fully developed, it is probable that the aggregation of machines responding to its demands will be similar to the disarray of flasks, core arbors, bottom plates, and other bric-a-brac of the foundry of antiquity; and I venture to suggest that some of the machines now heralded as world-beaters, and bolstered by everything except success, will be relegated to the stacks of brilliant ideas which then, as now, will occupy dusty and unmarked graves in foundry yards, their fast-disintegrating skeletons protruding.

Some things are called moulding machines which almost lack the number of parts to comply with the definition; for instance, a snap flask and the usual match, with a vibrator frame and a vibrator, is the most universally applicable hand moulding machine for small work that I know, yet all that has been added to the flask and the match to make this apparatus a machine is practically one piece, which need not weigh more than six or eight pounds, so far as its operation is concerned. From this to some of the elaborate process machines which have been developed for moulding specialties, the side bays of the foundry are lined with mechanisms, the mere naming of which would make a paper by itself; and yet the field of moulding in sand is not more than half explored. As one man has put it, the surface of the trade in moulding machines has hardly yet been scratched. When it is ploughed and sown and fertilised with an intelligent appreciation of what the moulding machine can accomplish, and the energy to make it accomplish this, the resulting crop will keep the moulding machine factories busy as they never have been; but no one machine will do the ploughing, nor will one man's brains conceive all the machines that will be required.

I make no attempt to illustrate moulding machines, for the reason that it evidently would be impossible to illustrate all, or even the types of them. And in the remarks which follow I do not mean to refer to the well-known special machines which are used for moulding such things as cast gears, pulleys, bath-tubs, water pipe, &c., for which the machine is built around its work, and in many instances consists largely of the patterns and their

* Read at the Indianapolis meeting, June, 1904, of the American Foundrymen's Association.

special arrangement, as in the case of a pulley machine adapted to moulding pulleys ranging in size from, perhaps, 10 in. to 30 in. on the same machine, with every conceivable width of face in these diameters, on which the patterns represent probably two-thirds of the weight and nine-tenths of the cost of the total machine.

As I have said, the simplest hand moulding machine I know is the vibrator frame, with its vibrator attached, guided in the pins of a snap flask, and used in connection with a match of the ordinary description, whether of wood, metal, or a litharge mixture. In such a frame any two-part pattern, which would ordinarily be moulded in a snap flask, may be fitted and rammed up, cope and drag, by hand. For a flask, say, 12 in. by 16 in., the total weight of this machine is not more than 20 lbs., including the flasks, and the whole thing can be hung on the wall. Put this with a hand squeezer, and it is still a hand moulding machine. Put it with a power squeezer, and it becomes a power moulding machine. Strictly speaking, the vibrator constitutes it a power machine, though the ramming is done by hand; but in a foundry where compressed air is piped about the shop (and foundries where it is not are now exceptions), a hose to a vibrator seems hardly a power connection.

Next in point of simplicity, so far as the machine is concerned, comes the hand-ramming, stripping-plate apparatus, in which, by many varying forms of linkage, a pattern support is moved vertically, while a frame of some form supports a stripping plate through which the patterns are drawn. The mechanism by which the patterns are manipulated, and the forms and materials in which the stripping plates are made, are now very numerous, and except for the expense of the stripping plate, and the necessity for attaching the patterns to separate support, there is no more generally useful moulding machine made. By a slight modification in the construction of the last-mentioned hand-ramming, stripping-plate mechanism, it is possible to use the same machine for either stripping plate or vibrator moulding, according to the nature of the work. Thus a man might have a deep spur gear on such a machine in which stripping the pattern was a *sine qua non*, and the next hour he might wish to mould on the same machine a crank or a valve or a valve wheel. This could be done by attaching half a split pattern to a flat plate resting on the same support which previously carried the stripping plate patterns, and placing on a frame, which before carried the stripping plate, a flask frame containing the guiding pins for the flask. The special constrction referred to n this machine is one which differentiates vibrator machines from machines on which vibrators might be used by attaching them to one part or another of the machine, but by which attaching the flask and the mould itself would be as much agitated as the pattern, which alone one wishes to affect. This construction, which is fully protected by patents, consists in an independent and elastic support for the pattern, so that this vibration does not extend to the sand, which would otherwise be more or less demoralised in the pattern drawing.

Perhaps, as I have begun with the simpler machines, it would be well to speak next of the squeezer, as it has been known for years. These machines are so well known, and so much in evidence everywhere, and have been for so long, that it is hardly more than necessary to mention them. We have all seen the evolution, which took years to effect, in these squeezers, changing the relatively inefficient side lever, nearly vertical in ramming, to the almost ideal horizontal lever, which even a lazy man can make work by sitting on it. These squeezers have been fitted with auxiliary apparatus, such as stripping plates, flasks, lifters, variable tucking blocks, and sprue cutters *ad libitum*, until the hand squeezer

equipment seems to have been as intelligently treated as any in the moulding machine business.

It is not a far step from pulling a lever by hand to making a cylinder do it, and there are now forty or fifty machines in existence in which the operator "presses a button" with his hand, and rams a mould, and then presses another button with his knee and draws the patterns.

Not more than half the patterns in use may be economically moulded by machinery without rolling the drag flask over, and stripping plate and vibrator, hand and power machines of many forms are now made to do this. When a pattern is drawn up, there is less excuse for a stripping plate than when a pattern is drawn down, and with four powerful vibrators acting on a follow board, deep and difficult "blind lifts" are easily made. When stripping plates are used, they may be operated by the machine, or they may be left to follow the sand by gravity. Gravity stripping plates are very old, but now and then they are reinvented, much as a new house is made out of an old one by a coat of paint. If the colour is sufficiently startling, you forget the old house in your amazement at the new.

It is nearly twenty years since a thoughtful foundryman jar-rammed the first mould mechanically, and it will not be long before most of the deep machine moulding now being rammed by hand is jar-rammed by machine.

I have but skimmed the surface of a wide new landscape, calling attention to a few prominent objects in a "bird's-eye view" of the new territory of the moulding machine. Foundrymen are watching keenly the development of this, to many of them, yet undiscovered country. They have money to invest; they see wonderful products of the region, and wonder what they need to cure them of the tired feeling we all suffer when we see that others are enjoying what we miss.

It is related of John Ericson that he did not allow physicians to prescribe for him. He would use the doctor's answers to his questions to diagnose his own case. Then with the entire pharmacopœia applicable to his case symptomatically labelled by the learned man, Ericson helped himself to his remedy. So, let me suggest that when you feel that you are suffering from what I might call mechanical prostration, you call in the open-minded practitioner with no hobby to ride, and quacking no patent medicine a cure for all your ills; see what there is to choose from, and diagnosing your own mould, make your own selection of apparatus. Regard whatever money you spend for the purchase of moulding machines as only the beginning of your investment. The cost of fitting the patterns to the machines comes after that, and you should not so order your machines as to be obliged to fit your patterns in only one way, and that perhaps the most expensive and most limited in application.

Anyone can buy moulding machines; few use them to best advantage. Nothing is doing more to develop the mechanic in the foundry foreman than the moulding machine, and the success or failure of either to-day marks the rise or fall of both in foundries which should use machines.

DISCRETION.

HAS any reader ever stopped to reason out why there is so much trouble and party feeling existing between the Foundry and pattern shop?

Isn't it, in a large number of cases, through want of tact and diplomacy on the part of either the management, foreman moulder, or foreman pattern-maker? Aren't we too ready to find fault with one another's work or the methods we adopt, whether it be the way the pattern is made or the method of moulding, shouldn't we always think first, that whatever method the foreman pattern-maker adopts in making the pattern and core box or the foreman moulder's method in moulding

pattern, he has some very good reason for adopting such method? Why are we so ready to condemn our fellow foreman before we know the reason and circumstances attending that particular case?

Why are we so apt to take the "bull by the horns" which usually finishes the dispute by causing a certain amount of ill feeling, and inwardly thinking the other side such cantankerous idiots?

Do not be too ready to think it is through pure cussedness that the pattern-maker has made that main core board 4 in. longer each end than the pattern, and didn't even mark the core print to that effect. "And now I have my core made it won't go in my box, but I have to cut through core irons and barrel, and damage my core in doing so. Why has he made the pattern joint one way, and that big core box the other?" Send for the foreman pattern-maker; let's have it out, etc., etc.; which usually ends up in a big row. On the other hand, a pattern and core box comes back from the Foundry into pattern shops to be handed or altered, and through an accident or carelessness, the boxes or pattern have got badly knocked about, scorched, and twisted, and perhaps burned, bosses, ribs, etc., missing, which is no doubt very annoying; but why make unnecessary trouble by calling the Foundry all the careless blundering idiots you can set your tongue to? We all agree its very annoying to see a new well-made pattern split, knocked out of shape, etc., simply through a moulder neglecting to draw a screw, that held that branch in place, but why didn't the pattern-maker circle that screw in chalk or blue pencil, then the mould would not have been broken?

Now, why not let us look at all these little troubles between Foundry and pattern shop with a more Christian-like spirit? Don't we allow our feelings to get the upper hand of us, and if old Jones is a "pigheaded old fool," we'll see what a little tact will do, and if tact and diplomacy fail, just console youselves with the fact that you cannot make a "silk purse out of a sow's ear," and if you know you are right and have a clear case, and yet you fail to convince your opponent through his ignorance, well, it's often the noblest mind that gives way. Yes, you will say, and always give in whether right or wrong. Truth, honesty, and right will sooner or later always find its correct level.

Aren't we transgressing too much by looking at troubles through our own personal spectacles? When we are employed by any firm, we are there for our employers' interest, not our own.

Does it not always want two to make a quarrel? Why be one of those two?

A foreman moulder or pattern-maker has quite enough worry and trouble from innumerable other sources without being troubled by his colleague, they are the very foremen who should help each other over difficulties, and make things as smooth as possible.

Oftentimes the manager is at fault. I have known many cases where the manager by diplomacy could have saved no end of trouble by the judicious handling of his foremen. In conclusion, we should be all working in our respective departments for one common end, and that is for the interest and good of our masters.

J. FAIRFIELD.

MACKENZIE & MONCUR, LTD., Edinburgh, have acquired the well-known business of Mackenzie Bros., Edinburgh Foundry, Slateford Road, disposed of to them owing to the death of Mr. Cossar Mackenzie. The Foundry section will be personally supervised by Mr. L. P. Mackenzie, who, for many years carried on the Edinburgh Foundry business with his brother, and who is now a director of Mackenzie, Ltd. The firm have added an electrical engineering department to their business under Mr. A. Donald Mackenzie, late Chairman of the Electric Lighting Committee of the City of Edinburgh.

STEELS CONTAINING NICKEL.

(*Continued from page* 200, *Vol.* 5.)

Influence which varying amounts of Carbon, Chrome, and Manganese have upon the Mechanical Properties of Nickel Steels.—Some very remarkable results were obtained at Imphy, by means of mechanical experiments, with a nickle steel which may, for the sake of reference, be styled N.C. 4, whose chemical composition was as follows:—

Nickel	20 to 25
Carbon	0·6 to 0·8
Manganese ...	0·5 (about)
Chrome	... 2 to 3

By its mechanical properties this steel resembles those so-called nickel steels which have not undergone "irreversible transformation," though it differs from them as regards its greater elasticity and its greater powers of resistance to breaking, as likewise by the degree to which it will stretch before breaking. It was in order to obtain this improvement in quality that a good addition of chrome was made to it and that the amounts of carbon and manganese were greatly increased.

The first steel N.C. 4, thus defined, having been obtained by a series of experiments, it was endeavoured to ascertain in what special way each of the respective elements composing this steel acted, as also to determine the influence which carbon, manganese, and chrome had upon the physical and mechanical properties of nickel steels containing good proportions of these three elements.

Influence of the Foregoing Elements upon the Allotropical condition of Nickel Steels.—Carbon, manganese, and chrome, all have a great influence upon the conditions in which the "irreversible transformation" is produced upon cooling—an influence which is even greater than that of nickel itself. The study of so-called nickel steels has clearly shown the preponderating influence of the position of the allotropical transformation point upon cooling, and has more particularly evidenced the important modifications which physical and mechanical properties undergo when this so-called "transformation point" goes below the ordinary temperature. An investigation of the physical and mechanical properties of this N.C. 4 steel, similar to that to which other nickel steels were subjected, will show that it owes most of its special properties to the very low position of its irreversible transformation point upon cooling.

The nickel steel referred to (N.C. 4) was not magnetic, differing thereby from all other so-called nickel steels, which are all magnetic. The powers of stretching which it possesses, along with its many other pronounced qualities, place it in a different category from nickel steel properly so called.

The authors of this interesting and scientific investigation as to nickel steels proceed to state that they have been able, owing to the courteous intermediary of M. Guillaume, who sent specimens of this steel N.C. 4 to Mr. Dewar, the eminent London professor, to profit from the intense cooling produced by liquid air. At a temperture of 188° C. magnetism did not appear unless it were in a specimen—which becomes slightly transformed—containing less carbon, chrome, and manganese than the others. This experiment has permitted the absence of magnetism and special mechanical properties of this steel to be attributed to a very appreciable lowering of the irreversible transformation point upon cooling.

The deduction was therefore drawn that carbon, manganese, and chrome, like nickel, have not only a direct action resulting from their special properties, but also an indirect action as a result of their influence upon the allotropical condition of the steel, and that this last action is

preponderating. It is not sufficient merely to show the influence exerted by carbon, manganese, and chrome acting simultaneously: it is necessary to bring forward the special action of each of these three elements.

As showing the action of carbon, it is worthy of observation that (as arrived at by the numerous experiments carried out by the authors) a few thousandth parts of carbon are sufficient to bring about an enormous reduction in the transformation point. Carbon plays the same *role* as nickel as regards the lowering of this point, at which a transformation is effected. It seems that 1 unit of carbon would produce the same reduction as 20 units of nickel.

This property of carbon has before been put forward by Osmond, in his classical experiments upon "Austénite," a steel composed exclusively of iron and carbon and non-magnetic at the ordinary temperature. This steel becomes transformed and magnetic when immersed in liquid air, and remains transformed upon the return to the ordinary temperature; in this case the transformation also becomes apparent by an increase in volume and hardness.

It is therefore seen that carbon alone can, like nickel, give to steel the property of undergoing the "irreversible transformation," with a lowering of the transformation point upon cooling to about —150° C. It is seen that it preserves this property when the steel contains nickel. But a great deal of art would be necessary to maintain uniformly distributed in steel not containing nickel, the proportion of carbon which produces "Austénite," for M. Osmond only succeeded in this by having recourse to tempering and was only able to obtain by this treatment a mixture of non-magnetic and magnetic steel containing about one-half of "Austénite."

In the presence of nickel, carbon remains uniformly distributed in the steel, hence it being possible to easily obtain a metal non-magnetic at the ordinary temperature, without having to have recourse to the art of tempering. However, the incorporation of a high proportion of carbon is only possible with the aid of an appreciable proportion of manganese, which must be higher and higher as the amount of carbon increases. It therefore results that carburetted nickel steels become at the same time, in a certain degree, manganese nickel steels, which accounts for the authors not pursuing beyond 10 per cent. the reduction of the amount of nickel without bringing into play a new auxiliary chrome.

It is none the less demonstrated that, excepting for the difficulty experienced by incorporating it in the steel, carbon must be considered as producing, like nickel, though in a greater degree, a lowering of the transformation point upon cooling, hence the possibility of obtaining without chrome non-magnetic nickel steels at an ordinary temperature, as N.C. 4, that is to say, only undergoing irreversible transformation at a very low temperature.

(*To be continued.*)

THE NEED OF STANDARD SPECIFICATIONS FOR GRAY IRON CASTINGS.*

By Henry Souther, Hartford, Conn.

IT is generally admitted that a good practical and commercial set of specifications for use by the many cast-iron purchasers does not exist. A few good sets are in the hands of large buyers, but even these are very different, contradictory, and not intended to cover a wide range of product. Most of these sets have been written to cover one industry only. It is strange that purchasers of cast-iron have not looked into this question long ago and demanded good, uniform cast-iron. Probably cast-iron has been discarded from many uses because of its

* Atlantic City Meeting of the American Institute of Mining Engineers, February, 1904.

failure in some few instances, even though the failure was due to ignorance of the quality of the iron, or perhaps to abnormally bad iron. It is not too extreme to say that some consider all gray iron from a given foundry alike and uniform, especially if they know it is made from certain well known brands of iron. It is likely that with standard specifications, and the increase of knowledge necessary to meet these conditions, the use of gray-iron castings will enter into fresh fields because of the certainty of quality. This was the case when steel replaced wrought-iron, for the reason that it was made of a uniformly good quality, and was thoroughly reliable. The foundryman, therefore, should welcome any good commercial steps taken in the direction of securing standard specifications for cast-iron. Uniformity of product in soft steel is comparitively easy to bring about, and yet the most rigid specifications are in common use by the purchasers of this material.

Uniformity of product in cast-iron is not easy to attain because of the greater quantity of impurities in it, yet specifications for soft steel are common, while for cast-iron they are rare.

In steel, only carbon, phosphorus and sulphur are of prime importance, manganese, silicon and copper being secondary, and all of these impurities exist in very small percentages.

In cast-iron, however, silicon, sulphur, carbon and phosphorus are of vital importance, and are present in comparatively large percentages. Furthermore, each impurity is capable of notably altering the quality of the metal. Manganese also as a secondary element is to be intelligently regulated to advantage.

Yet cast-iron with the greatest possible variation in composition is neither watched, inspected nor tested in spite of the immense differences possible, while soft steel which may vary but little in comparison is submitted to a careful examination before it is accepted. This circumstance is not due to the fact that cast-iron is not used at critical points either, because it is used in making columns, the breaking of which may wreck a building, as cast-iron enters into the manufacture of high-pressure valves and fittings that may wreck a boiler or an hydraulic system, as well as into many other important uses.

Not only is cast-iron subject to chemical and physical differences under normal conditions, but, like most cast metals, it is liable to have bad internal flaws and latent defects not possible to detect by any other means than a test to destruction. In many cases these defects are the indirect results of bad chemical conditions, for example, a high sulphur percentage, and it is for this reason, if for no other, that a limit to the sulphur-content should have a place in cast-iron specifications.

In certain grades of gray iron an unusual strength is demanded, and in many instances it is convenient to make this grade in a reverberatory or air-furnace. Under the specifications submitted, either method is permitted, each being believed to be good, but, unless otherwise specified, the cupola-furnace will be used. It is known that some founders produce all grades of castings in the cupola-furnace successfully, by the intelligent use of both iron and fuel.

It is believed that light iron castings should be more free from sulphur than heavy ones, because the presence of sulphur induces chill, shrinkage, and such flaws as are grouped under the broad head of "dirty iron." All of these defects are more serious in light work than in heavy; the chill, because it is possible in thin iron and not in thick iron, the latter containing so much heat as to cause it to anneal itself in cooling; shrinkage, because light castings chill quickly, form a small, close grain, and shrink more in consequence; whereas heavy castings cool slowly, form large, open grain, and shrink much less; and flaws, because a flaw of a given size forms a much more serious defect in a light

casting than in a heavy one. It is a fact that flaws induced by the presence of sulpur do not decrease in proportion to the decrease in the bulk of a casting, and it is common to find shot-holes in small castings of about the same size as those in much larger castings.

The sulphur-limits placed in these specifications are within the commercial reach of any well-regulated foundry, and necessitate no extra cost. The low sulphur-limit for heavy castings has been objected to as unnecessarily low, but it is on the safe side, and is an insurance against bad flaws, and should be retained for the reason that it does not increase the cost of the iron.

Cast-iron with high sulphur-content is sometimes stronger than with low, because the grain in the former instance is closer, a condition which always tends to increase the strength; but of what use is the extra strength if at some vital point in the casting flaws exist as a result of high sulphur-content, that weaken it and far more than offset the extra strength of the sound parts of the casting?

Even if it is assumed that a test-bar representing a cylinder does show unusual strength and is of high sulphur-content and sound at the point of rupture, the casting itself may contain enough shot and blow holes to cause failure.

A high sulphur-content is a menace in any casting, whether it can be detected physically or not, and this impurity should be excluded as far as possible commercially.

The author gives several tables, of which he says: "I was not able to get reliable information in all cases. The bars are from six Foundries, making products very varied in character."

From the same foundries the results of testing the inch-square bars selected at random from recent tests are given in comparison.

The theoretical ratio of strength of the inch-square bar in common use, as compared with the arbitration bar, is about 0·8 to 1, or, to be exact, 0·867; that is, the inch-square bar is about 80 per cent. as strong as the 1¼ inch round bar, all things being equal. Actual results do not follow the theory exactly, for the reason that the greater volume of the arbitration bar results in its being softer, all other things being equal. There is also a lesser proportion of chilled metal in the round bar.

The worst enemy of the cast-iron test-specimen is the physical defect or flaw. Fewer of the round test-bars contain flaws than of the square. It is apparent that the sharp corners by capillarity or similar influences attract rising bubbles of gas and entrap them in the quicker cooling metal contained in the corners. This effect alone places the round bar superior to the square as a fair representative of a cast.

After obtaining more data it may be found that higher strength-limits are possible and advisable. With the ones given, however, uniformity and good quality are ensured, which is the main object to be desired at present.

No upper-strength limit has been placed, as this factor is controlled by the machining properties of the iron. It is my opinion that a drilling test would be the best safeguard against a too hard iron. As not enough data exist at present to make proper commercial limits, this matter is one that should be thoroughly investigated.

A minimum limit for deflection has been placed in the specifications to guard against a strong but brittle iron. Such iron is not often met, but nevertheless it is a factor and should be guarded against. Some of the tests given show a lower deflection, but most of them were due to the fact that the bars were cast with a sectional mould, the attached fins being subsequently ground off; other low deflections were due to accidental defects, and in one set the directions for casting had not been followed and the bars had been roughly ground, which removed the skin in spots.

The normal specimens cast as directed

were better than the standard demanded, and were as good as that warranted by the chemical composition.

Nothing new is offered in this particular. The strength limits correspond to the ordinary demands so far as made of the present trade. A uniform gripping device should be adopted as far as possible for the reason that the grip is of vital importance in testing cast-iron for tensile strength.

The classification made is approximate and will naturally be supplemented by buyers, who will specify that a given casting must conform to the specifications applying to one of the grades. This will remove all uncertainty as to which class may be meant.

It was the first choice of the committee that a 1·5 in. bar might be used, in fact, a bar that would be as large as possible in order to be free from all chilling influences and defects resulting from sudden cooling; in short, a less sensitive bar. It was seen that such a bar would break at too great a strength and be beyond the limits of the majority of testing machines now in use in Foundries. A diameter of 1·25 in. was therefore adopted as being satisfactory, all things considered.

The question arose of having one standard size of test-bar as compared with having several, in order to make an approximate comparison of thicknesses with the castings under inspection, and thus duplicate the actual cooling conditions. This is not possible, because any separate bar must cool more or less slowly than the casting, and any coupon-cast as a part of the casting must be machined before testing. A test of this kind made without the skin does not represent the actual casting, nor can like conditions be duplicated at will in this way.

By having a standard bar it is perfectly possible to estimate the strength of any other bar or casting, just as in the case of the steel maker who rolls a standard test-bar, say $2\frac{1}{2}$ by $\frac{3}{8}$ in. in section, from a small 6 in. square test ingot, and from the results obtained is able to foretell the strength of the same steel rolled into a $\frac{3}{8}$ in. rod, a 0·5 in. angle-iron, or a 1·25 in. plate. It is all a question of heat treatment and speed of cooling, and in this respect cast-iron is similar to steel. Cooling conditions follow very definite laws, well recognised by the average Founder without his analysing the reasons. Any grade or quality of cast-iron may be purchased with the arbitration test-bar as specified, as well as by a dozen different sizes of test-bars. It is a matter of comparison at the best, and one standard is enough.

As a study it would be interesting to cut out specimens from all sizes of castings as far as possible, and the results would form a basis for future comparison, but as a commercial custom this suggestion is practically and commercially out of the question.

The importance of the tensile test has been minimised because of the great difficulty of making true tensile tests. Abnormal strains are sure to creep in except in the most carefully constructed machines operated by the most skilled observers. The transverse test is within the reach of all, and, in fact, corresponds with the conditions of actual use much closer than does the tensile test, and no serious abnormal strains are possible with the ordinary testing machine.

The occasion is likely to arise in which the tensile test will be advisable, to meet which the provision noted in the specifications is inserted. The shape of the specimen resembles quite closely the one in use by the Government, but it has been modified to meet the needs of the piece from which it is to be cut, as well as of other practical considerations. It has been made as short as possible to eliminate the chance of including flaws, and it has been lengthened as compared with the Government specimen, which is likely to give abnormally high results.

Probably the most important source of varying results in cast-iron tests has been

the uncertain conditions surrounding moulding and casting. There never has been any uniformity in this respect, yet it is a well-known fact that cast-iron is very much influenced by various chilling effects, and is extremely sensitive to all heat variations. Some foundrymen have made the moulds in sand that is quite moist, and others in sand that is very dry. Some have knocked the test-bar out of the mould as quickly as it became cool enough to stand it. Some have cast the bar on end, some flat, and some inclined, the variations being nearly as many as the number of founders. It has, therefore, been provided that the mould shall be dry and cool before the bar is cast, and the other conditions shall be observed which will tend to produce uniform castings.

I note that by some error a provision to prevent the knocking out of the test bar from the mould has been omitted. This provision was contained in the instructions sent for casting the bars tested, and I doubt that all the conditions were observed, for if one infringement in the matter of casting in a parted mould was made, probably there were others. These differences undoubtedly account for some of the abnormal variations.

Some of the bars submitted for the test were cast in a parted mould, producing fins of greater or less thickness, which were chipped or ground off. The result of this condition was that less deflection resulted, even though the fins were placed at the neutral axis of the test specimen.

The provision stating that the test bars should not be treated in any respect before testing has been found to be most important. The facing of the mould has been particularly specified, so that the test bar shall strip from the mould in fairly good shape, and be ready for the test.

The objection has been made that the bars could not be made sufficiently uniform in diameter—an effect which is more or less true when the iron is cast in a green sand mould; but with the stated casting conditions which prohibit the rapping of the pattern, and with the use of a dry mould and a given facing, this objection has almost disappeared, and has become of extremely small importance. Measurements made of 20 bars show a maximum variation of but 0·039 in. in an average diameter at the break of 1·236 in.

Measurements of Arbitration Test Bars at the Point of Rupture.

No. of Specimen.	Diameter in Inches.	No. of Specimen.	Diameter in Inches.	No. of Specimen.	Diameter in Inches.
1	1·240	8	1·246	15	1·180†
2	1·241	9	1·273	16	1·236‡
3	1·231	10	1·231	17	1·243
4	1·221	11	1·234	18	1·245
5	1·233	12	1·242	19	1·259
6	1·244	13	1·220*	20	1·238
7	1·236	14	1·233		

It is interesting to note that the only bar cast with fins, that is, in a parted mould, was the most abnormal of the lot, which ought to be considered a most excellent endorsement of the proposed method of moulding.

The question of the character of the supports to be used during the test has been raised, but it is believed that little need be feared on this account, as the testing machines in common use are safe in this matter. The two end bearings used were flat surfaces intended to rotate on a round bearing. The rotation was not perceptible. Either bearings of this kind, or blunt knife edges, in all probability, would answer equally well.

The time limit of the test has been placed to meet ordinary practice, as near as can be ascertained. In all events it is within reason, and as long as the practice is made uniform by different observers, it is of comparative small moment.

This simple provision has been made with the understanding that the boring shall be taken after removing all of the

* This bar was ground smooth.
† This bar cast with fins.
‡ Rounded off by grinding.

surface matter. In case graphitic carbon enters into the case, the sample should be taken across the entire face or cross-section of the bar and thoroughly mixed—a procedure which is necessary because of the difference in graphitic carbon existing between the exterior and interior metal of a specimen of the size in question.

I recognised that these specifications for gray-iron castings are not ideal from every standpoint, nor is it possible that any commercial ones may be. Theory must yield to practice all along the line, and every engineer or manager discovers this fact very early in his connection with manufacturing conditions.

The committee believes that by means of these specifications the purchaser of gray-iron castings will be able to obtain a more uniform and reliable product. It is also certain that there will be correspondingly less friction, because an order for iron castings will be definite as to quality, and if the Foundry makes them to fill the specifications, there can be no dispute as to the quality of the iron furnished because some machinist thinks it machines hard or thinks it looks weak.

AMONG THE FOUNDRIES.

Messrs. Craven, Smith, & Shackleton, have started an engineering business at the Swan Ironworks, Keighley.

The Meadow Foundry Company, Limited, of Mansfield, have removed their London office to 58, Upper Thames Street, E.C.

The Stirling Water-tube Boiler Company have secured a contract for ten water-tube boilers for the electric power station of the London County Council.

The Wilfruna Works Company, Wolverhampton, recently received from India a large order for Turner-Miesse steam motor-cars.

S. Fox & Co. have executed an order from the Burma Railways Company for the supply of 200 volute springs for rolling-stock.

Bennett's Industrial Foundry Company, Limited, of Ardwick, Manchester, have removed their London office to 58, Upper Thames Street, E.C.

H. H. Vivian & Co., Ltd., have executed an order for the supply of 1,440 brass boiler tubes, to the Bengal-Nagpur Railway Company.

J. Reid & Co., Ltd., have a large order for the supply of axle guards, buffers, and fittings for carriages, to the Burma Railways Company.

Robert Stephenson & Co., Ltd., of Hebburn-on-Tyne, have recently secured an order in connection with the drilling and riveting of armour plates for Japan.

Ashmore, Benson, Pease & Co., Ltd., have just completed a cast-iron water storage tank for Messrs. Plews & Sons, of the Vale of Mowbray Brewery.

Williams & Robinson, Ltd., Rugby, have received an order from the Stanton Ironworks Company for two steam dynamos for supplying light and power to their furnaces.

T. Turton & Sons, Ltd., have complied with an order for the supply of 200 laminated bearing springs, for vehicle stock, to the Burma Railways Company.

Beyer, Peacock & Co., Ltd., Manchester, are manufucturing a lapping and grinding machine for the Burma Railway Company's Insein worshops.

The Metropolitan Amalgamated Carriage Company, Limited, have an order for the supply of ironwork, &c., for high-sided wagons, to the South Indian Railway Company.

Kitson & Co., Ltd., the well-known manufacturers of locomotive and other engines, have a large order for the supply of locomotive duplicate parts to the Burma Railways Company.

Andrew, Barclay, Sons & Co., Ltd., of Kilmarnock, have secured a contract from the Belfast Harbour Board for the supply and erection of engines, pumps, &c., for the new graving dock.

Hayward, Tyler, & Co., Ltd., have an order for the supply of double force pumps, and Hayward Brothers and Eckstein for the supply of area lights to the South Indian Railway Company.

The Midland Railway Carriage Company, Limited, are complying with a large order for the supply of underframes for covered goods wagons, and for brake-vans, to the South Indian Railway Company.

Meldrum Brothers, Ltd., Timperley, near Manchester, have just secured the order for a refuse destructor to be erected at the Sewage Works, Twickenham, the power to be used for sewage pumping.

Mather & Platt, Ltd., have been awarded by the Admiralty the complete contract for the whole of the plant to be erected at the dockyard, Simon's Bay, Cape Colony, for supplying electricity for lighting and power.

Cammell, Laird & Co., Ltd., have an order for the supply of springs for rolling-stock to the South Indian Railway Company, and P. W. MacLellan for the supply of fittings for carriage and wagon stock.

C. A. Parson & Company, of Newcastle-on-Tyne and Glasgow, have installed one of their special gas exhausters driven by a steam turbine at Coltness Ironworks. Two similar plants have since been ordered for the same works.

Guest, Keen, and Nettlefolds, Ltd., are complying with an order from the Bengal-Nagpur Railway Company, for the supply of 50,000 steel keys, 536 tons of 85 lb. rails, 22 tons of fish-plates, and 5,200 fish-bolts with nuts.

The Patent Shaft and Axletree Company, Limited, have a large order for the supply of disc wheels and tyres for rolling-stock to the South Indian Railway Company, and Pickering & Co., for the supply of spoke wheels for vehicle stock.

The Consolidated Pneumatic Tool Company, Limited, are manufacturing two of their portable pneumatic rivetting machines for the Jamalpur workshops, and J. Spencer & Co., four high-speed sensitive drilling machines.

Higginbottom & Mannock, Ltd., Manchester, have secured the order for twenty movable electric "Goliath" jib-cranes, to lift 30 cwt. each, 34 ft. radius, 57 ft. high, for the New Salford Docks of the Manchester Ship Canal Company.

Marshall, Fleming & Jack, of Motherwell, have secured from the Great Western Railway Company the contract for all the cranes and runways for their generating station at Park Royal, and the various sub-stations connected therewith.

Mr. J. S. Hall, Newark-on-Trent, has just despatched to a very large cold stores in the North one of his patent automatic hoists for loading and unloading from any floor carcases of mutton and kegs of butter at the rate of 600 per hour through five doors; total height, 65 ft.

A contract for about 3,000 tons of cast-iron pipes, 3 in. in diameter, for use in connection with the laying of the extension of the underground telegraph system between England and Scotland, has recently been placed by the Postmaster-General with ironfounders in Scotland. The order has been apportioned among several firms in Scotland.

Sir William Arrol & Co., Ltd., Dalmarnock Iron Works, have secured a contract for a large bridge over the Suir, which will practically complete the scheme of the Great Western Railway of England and the Great Southern and Western Railway of Ireland to bring the South of Ireland and the Metropolitan district of England closer together.

The Vulcan Foundry, Limited, of Newton-le-Willows, Lancs, recently delivered to the order of the Western Australian Government Railways thirty powerful six-wheeled coupled bogie express locomotives of a new type. These engines have cylinders fitted with the Walschaert motion, and diameters of

17 in., whilst the stroke is 23 in. The boiler pressure is 175 lbs. per square inch, and the heating surface 1,418 square feet, to which the firebox contributes 118 square feet, and the tubes 1,300 square feet.

The Whessoe Foundry Company, of Darlington, have recently secured, in face of severe American and other competition, an important order for the erection of a large gasometer and other accessories, together with several purifiers, at Winnipeg, Canada. The capacity of the Winnipeg gasometer will be three-quarters of a million cubic feet of gas. The Whessoe Foundry Company have also received an order for a gasholder and steel tank for Whitestock, Capetown, the gasholder in this instance being specified for a cubic capacity of 500,000 ft. of gas.

MIDLAND NOTES.

FROM OUR OWN CORRESPONDENT.

YOUR correspondent had the privilege the other day of visiting the extensive Swan Garden Ironworks, that are in a state of dismantling by Messrs. Thos. W. Ward, Ltd. He states that some of the floor-plates that are being broken up for cast-iron scrap are of the very best quality, and adds they were made over sixty years ago when iron was iron.

Messrs. Joseph Evans & Sons, Calwell Foundry, Heath Town, are sending to Pendleton Collieries, Lancashire, one of the largest pumps ever made in the Midlands. It weighs over 86 tons, and bears signs of the excellency of the moulder's art.

That the trade in the Midlands is very bad is only expressing in a mild form the exact state of things. It is improbable that in the memory of any living being the depression that just now exists can ever be remembered to be equalled in its intensity. During the last few days four large firms have suspended payment, and it is thought that the quartette will have to face bankruptcy.

The Woodside furnaces, belonging to Messrs. Cochrane, have been curtailed in their producing capacity, and it is likely that the only blast-furnace now in operation will be blown out in a few days. The pipe-making section of these works has for a considerable time been only partially employed, among the reasons put forth for this state of things is one of underselling on the part of the manufacturers more than all the competition of foreign iron and steel. Ironmasters inform us there is absolute disloyalty to each other after aggreeing at prices they shall accept. The current consumption does not justify the methods of taking each other's customers and asking for payment before the usual period, gives buyers the option of undue advantage. The ironworkers themselves are more in common agreement than are their employers.

On the 8th inst. a labourer employed at the Tipton Green Furnaces met with a terrible death. The deceased, who was named John Swan, Whitehall Road, Greet's Green, was wheeling limestone on to a lift, but he apparently did not put his barrow clear. He started the lift, and when it had ascended some five yards it caught a piece of angle iron, and, in trying to save himself, he was caught between the lift and the piece of angle iron, and sustained shocking injuries resulting in death.

SHEFFIELD NOTES.

REPORTS on all hands as to the state of the iron and steel trades of the district do not produce any evidences of change from the unsatisfactory state of things which has prevailed in the district for some time. The half year closes very much as it began, that is to say, no important developments having taken place during the six months.

The only departments worthy of record being the steady expansion of the high-speed tool steel trade, and the prosperity in tramway and light railway specialties, points, crossings, etc. With the increase in the demand for high-speed steel, it should also be mentioned that the demand for the lower classes has shown a decrease, therefore, the output of tool steel generally can only be described as normal.

Government work of every description remains very scarce, and what is on hand is in a fair way to completion.

The engineering branches continue to remain very quiet, and the general state of the foundry trade both iron and steel is unaltered.

The latest quotations of prices in Sheffield are as follows: Lincolnshire pig-iron 44*s.* to 45*s.*; Lincolnshire Foundry iron 45*s.* to 46*s.*; Derbyshire forge-iron 44*s.*; Derbyshire Foundry-iron 47*s.* to 48*s.*; East Coast hematites 58*s.*; West Coast hematites 64*s.* to 65*s.*; bar-iron £6 10*s.*; Sieman-Martin £7 10*s.*

A singular fatal accident occurred at Messrs. W. Jessops & Sons Foundry on June 27th, to a man named John Gowney. A large pinion wheel had been cast, and Gowney was going through the process of fettling it, when, without warning, it suddenly burst, a piece of the wheel weighing close upon a ton falling upon the unfortunate man.

It is interesting to observe that in spite of somewhat severe competition the Moss Bay Hematite Iron and Steel Company of Workingham have secured a contract for 18,000 tons of steel rails for the Argentine Great Western Railway Company.

SCOTTISH TRADE NOTES.

(By Our Own Correspondent.)

THE Scottish Foundry trade is still exceedingly quiet. Orders are difficult to obtain alike for heavy and light castings, and the vast majority of foundry firms are working short time. The holiday season is now in full swing, and that means that business will get a further set back, and fresh work will not come in with anything like the ordinary volume till the autumn. When the heads of the retail firms are on holiday the travellers of foundry firms cannot obtain substantial orders, and on that account, and also because of the continued depression in the building trade, business will be quieter than it even now is for a month or two. Profits on what work is leaving the foundries are still low, and firms are now studying economy. This has been particularly manifest in the Falkirk district this month, several foundry firms having declined to give their workmen their usual donation towards their annual excursion. This act of liberality has been in some cases so long extended that the men have thought it indispensable, and they have abandoned their annual trip.

The formation of the British Foundrymens' Convention has been referred to in lengthy paragraphs in the Scottish press, and has been favourably commented upon. I would urge on all Scottish foundrymen who can do so to be present at the next meeting to be held at Manchester in connection with the Convention, as the movement is one which is bound to be accompanied with highly-beneficial results.

Considering the fact that the foundry trade in Bonnybridge has been in a depressed state for some time back, and that the working days of a great many of the hands have been reduced to four, the news that a new foundry is to be started in the place has come as a pleasant surprise to the people of the district. It is the intention of Mr. Lane, late secretary of the firm of Smith & Wellstood, Ltd., Ironfounders, Bonnybridge, and formerly a partner in the concern, to set up a new foundry near the railway station. Several acres of suitable ground have been acquired for the purpose, and the erection of a fairly large foundry, in which general light

castings will be manufactured, will be proceeded with without any unnecessary delay. The new establishment gives promise of being an important concern. Mr. Lane, who has a capital colonial connection, will devote special attention to the manufacture of stoves and ranges for the colonial market, for the production of which Bonnybridge has, for a long number ot years, had a great name. From the outset a good many men will be employed at the foundry, and should it prove a success, it will give a decided fillip to the development of Bonnybridge, which has occupied an almost stationary position for a number of years past.

The announcement as to the starting of this new foundry at Bonnybridge has come as a big surprise to most people in the trade. There is a feeling that the days or the years of big profits in the Scottish ironfounding industry have gone past, and several public limited liability companies have not been able to satisfy their shareholders. It is no doubt true that failures in the trade have been almost unknown, but what with bad trade, keen competition, and the cutting of prices, together with big failures in the retail trade, the old order of things may be reversed at any moment. Despite the depressed and unsatisfactory tone in the Scottish ironfounding industry, Mr. Lane has the fortitude to proceed now with the erection of a new foundry.

He knows the business well, and possibly his view of the immediate future of the trade differs from that of those now engaged in it. If that be so, it is hoped he is right. In any case, no effort will be awaiting on his part to secure success for his new venture.

The history of the ironfounding trade of Bonnybridge is not without interest. Some twelve years ago there was in the place two ironfounding concerns of large dimensions, and of a fair age. These were Smith & Wellstord's Columbian Stove Works, and Mr. George Ure's Bonnybridge Foundry. The former firm was one of the pioneers in the colonial stove trade, and the latter did a considerable business in general light castings, which included sewing-machine castings, and the making of piano frames. Only the public road separated the one foundry from the other, and as the business of Smith & Wellstord was older than that of Mr. Ures, the ground taken up at the starting of the Foundry was, in the course, of time, entirely built upon, and there was no room for further extension. Consequently the two firms amalgamated, just as M'Dowall Steven & Co., Milton Iron Works, Glasgow, and Laurieston Iron Co., Falkirk, have done within the last month or two, name of the older established and and best known concern—Smith & Wellstood—was retained for the amalgamated business. The change has wrought admirably. The concern was floated as a limited liability company, and many of the workers took up shares. Of the original promoters of the two foundries much that is of interest could be written. The late Mr. Smith, of Smith & Wellstood, when on a voyage to the colonies during the early part of last century, was wrecked, but was picked up in a basket after having been tossed about in the Atlantic for some time. Mr. George Ure, of the Bonnybridge Foundry, is a veteran in the trade, and one of the best-known Stirling county gentlemen. He was the first chairman of the Stirling County Council, and on his retirement from the office on account of his advanced years—he is now an octogenarian—he was presented with his portrait in oils. The firm of Smith & Wellstood, Ltd., have their London showroom and warehouse in one of the most conspicuous parts of the metropolis. The site and building is their own, the site, which is very valuable, having been acquired by Smith & Wellstood many years ago. In more recent years quite a number of small foundries have sprung up in the neighbourhood of Bonnybridge, one of the latest of these being that of the Stirlingshire Stove and Range Company.

An important addition has just been completed at the Diamond Foundry. To the east of the works, and alongside of the main line of railway between Edinburgh, Grahamston, Stirling, and the north, a splendid new warehouse has been built. The warehouse, which is a lofty and well-lit building, with a cement floor, is 120 feet long, by 90 feet broad, and is to be used for the storage of fitted gas-stoves. During the winter several thousands of these, of various patterns and sizes, will be made and stored in the new warehouse, and judging from the firm's past experience, these will be readily disposed of during the summer. The railway siding and loading bank has also been extended along the full length of the new building. The Davis Gas-Stove Company, London and Luton, who are the owners of the Diamond Foundry, is one of the few foundry firms that has of late been doing a really paying business, their last year's dividend being 12 per cent.

In past years the whole of the Falkirk and district ironfoundries have been closed on the trade's holiday week—the first week in July. There has this year, however, been a departure from the rule. The employees of the Davis Gas-Stove Co., Ltd., Diamond Foundry, Falkirk, were working full time during the holiday week, while the employees in all the other foundries in the district were on holiday. It appears that the month of June and the beginning of July is the busiest season in the gas-stove trade, and in that branch of business the firm have of late been unusually busy. It is thought by the firm and their men might work on during the Falkirk holiday week, and observe the holidays which have been fixed for their London house—the first week in August. The men were asked if they would agree to this, and they unanimously acquiesced. Considering the disagreeable state of the weather during the ordinary holiday week in July, the men did not regret coming to this decision. I have heard of another Scottish foundry firm, in a similar line of business, who also desired their men to work on till August. As, however, they did not go so diplomatically about the matter, and take their workmen with them, they met with a point-blank refusal. In the case of the Davis Gas-Stove Co., they got their men to work on without the slightest friction.

NOTES.

Malleable iron, in market lengths and otherwise, in exactly the same state in which it left the rolling mill, can now be imported free into New Zealand as bar iron.

The new electrical steel swing bridge, weighing 300 tons, which is to carry the railway for the transatlantic boat trains across Dover Docks, was swung into position on the 16th inst. It has been built by Messrs. Pearson in the record time of eighteen weeks.

Mr. Alfred Brown, iron and steel merchant, &c., Barrow-in-Furness, has entered into an arrangement with Herbert and Gilchrist, 146, West Regent Street, Glasgow, to co-operate with him as sub-agents for the sale of Skoda castings in the Glasgow and Clyde district.

Taylor Brothers & Co., Ltd., have executed an order for the supply of 200 cwts. of Yorkshire iron to the Burma Railways Company. The price of Yorkshire iron has been ranging lately from £20 15s. to £21 10s. per ton, according to the port of shipment, f.o.b.

In view of the fact that iron mines in Furness are nearly worked out, the discovery of what is supposed to be a rich vein of ore will be welcome news to iron-masters. For some time boring operations have been going on over the district, and a few days ago ore was found by the side of the Furness Railway, near Park Station. The Barrow Hematite Steel Company had the boring operation in hand.

During the last few days the old railroad which has for nearly a century served for the purpose of transporting the coal from the colliery to the works of the Birtley Iron Company, and also to the Tyne for shipment, has been abandoned, having been replaced by a new railway of more modern construction. The Birtley line was one of several tram lines in regular use long before the opening of the Stockton and Darlington, the first public railway, in 1825.

During the past two years, says the *Birmingham Post*, some very extensive and important alterations and improvements have been effected at the Spring Vale Steel Works of Sir Alfred Hickman, Ltd., Bilston, and a successful start has now been made with the new methods which have been adopted. At the blast furnaces the best appliances have been added from time to time, in regard to the blowing engines, to increase the output. The improvements just adopted provide for a new process of delivering the molten metal from the blast furnaces direct to the steel works. Instead of the metal being run into pig-iron moulds, it is now delivered into ladles, each holding about twenty-five tons. The metal is thence conveyed from the blast furnaces by locomotives to the steel works, and on arriving there the vessels are lifted by hydraulic power, and the contents emptied into a new mixer, with a capacity of 200 tons. The metal is thence passed into the mills, where it is rolled down to the requisite sizes and lengths according to the specifications of customers. This obviates the heating and re-heating of the iron, and dispenses with the trouble of dealing with sand. By the new improvements, the proprietors hope to equal what is done in America, to carry the hot metal from the blast furnaces, and manufacture it into articles without its getting cold. The expenditure in carrying out the improvements has been heavy, but it has been done to retain the industry in the district.

Already the London County Council are considering the questions of promoting two important engineering works in the next session of Parliament, the Bridges Committee having decided that they should be proceeded with at once. One is the reconstruction of Lambeth Bridge, at a cost of £872,000. This bridge completes a main line of communication between the South of London and the West End around Victoria and Pimlico; and the present suspension structure is in such a state that vehicular traffic is allowed only to walk over. No heavy cart is permitted to pass, and when there is any likelihood of a crowd collecting the bridge gates at both ends are closed. An indication of the extent of deterioration is afforded by the fact that as much as 16 lbs. of rust have been removed at one time from between the strands of a 5 ft. length of cable. Sir Benjamin Baker has condemned the structure. The committee have considered the question of a masonry arched bridge, or a girder structure, but had to depart from the idea of the former, as it would have limited the headway for steamboat traffic. The width of the river here is 828 ft., and a bridge of quite this length, and 60 ft. wide, is proposed, which, with the acquisition of property, the building of embankments, &c., will involve an expenditure that will necessitate an addition to the rates of nearly ¼*d.* per pound for interest and sinking fund.

CORRECTION.—The illustration of a blast-furnace gas engine shown on page 215, last month is in operation at SHEEPBRIDGE WORKS near Chesterfield, and not as stated.—[ED.]

NOTICE.

Nous Adressons THE FOUNDRY TRADE JOURNAL *pendent une année, dans tous les pays, franc de porte, pour la somme de 9 francs 50 centimes. Cette somme peut nous être envoyée par Mandat-Poste international ou par chèque payable en Angleterre.*

SCRAP-IRON SPECIFICATIONS.*

By W. G. Scott.

"SCRAP-IRON" is the name usually given to the miscellaneous collection of broken and worn-out castings used along with pig-iron in making foundry mixtures. Strictly speaking, the term applies more appropriately to the conglomeration of iron known as "foreign scrap," or that which is obtained from the junk dealer, who makes a business of collecting such material. Home scrap—consisting of gates, sprues, risers, defective castings, and "shot-iron"—is more properly termed "the remelt," and at the present time, where most foundry mixtures are made by analysis, its composition is not considered as an "unknown quantity." The object of this paper is a general classification of the material known as "foreign scrap," which at the present time, in many cases, is purchased by specification.

Under the head of foreign scrap may be included the following kinds of material, viz.: Grey iron, chilled irons, malleable iron, cast borings, steel, wrought-iron, and steel or wrought-iron borings. The common grey iron cupola founder will prefer a good grade of grey iron scrap; the malleable iron founder may wish to include steel scrap; the Mitis metal-maker will want wrought-iron, and the cast-steel producer may require something else; therefore the necessity of a general classification. The writer has been requested by several large manufacturing concerns to classify the material in such way that it may be controlled by specification if desired, but, as a rule, such classification can only be brought about by the purchaser insisting upon the agent or junk dealer sorting the scrap, or, in case it is not sorted, to claim a rebate before paying for the material. It is proposed to classify foreign scrap as follows:—

(1) Light machinery scrap (grey iron).
(2) Heavy machinery scrap (grey iron).
(3) Stove plate scrap (grey iron).
(4) Car wheel and chilled iron (grey iron).
(5) Cast borings.
(6) Malleable iron scrap.
(7) Steel scrap.
(8) Wrought scrap.
(9) Mixed scrap.

It is impossible to establish a cast-iron rule, or to formulate a rigid specification in regard to the classification of scrap, as such a course would have a tendency to raise the price of the better grades and force the culled material upon the small foundries.

It is proposed to briefly describe the kind of material suitable for each particular class, explain its proper use, and give a general average analysis of the iron or steel.

1. *Light Machinery Scrap.*

This class of scrap will usually consist of the broken parts of agricultural implements, sewing machines, ornamental iron-work, cast fixtures, &c. Most of the material will be less than 2 in. in thickness, except certain portions like the hub of a wheel, or perhaps a large support; as a rule, however, the iron will be thin, and consequently should be soft. The average analysis of light scrap will generally be found to be within the following limits:—

Silicon ...	2·00	to	2·60	per cent.
Sulphur ...	·075	to	·095	,,
Phosphorus	·70	to	·90	,,
Manganese	·20	to	·60	,,
Total carbon	3·00	to	4·25	,,

*Read at the Indianapolis Convention of the American Foundrymen's Association, June, 1904.

Light machinery scrap is considered superior to all other grades for general grey iron work. It increases the strength of soft iron mixtures and produces but little slag, unless much rust be present, in which case it has a tendency to harden the iron somewhat, and increases the "melting loss," the rust uniting with the slag to form silicate of iron, which is an undesirable element in good cupola practice. The proper amount of scrap to be used in melting will, of course, depend upon the quality of castings desired. The usual amount is from 30 to 50 per cent., but with a medium low sulphur and the desired silicon there is no objection to an unlimited increase. Some foundrymen use all scrap with a little ferro-silicon softener and a small amount of ferro-manganese, but such mixtures are uncertain and cannot be controlled by analysis or otherwise. Increase in scrap means decrease in total carbon, hence the iron becomes harder, stronger, and more close-grained. Light machinery scrap, if sorted, costs almost as much as pig-iron, therefore in most cases the buyer makes no distinction between light and heavy machinery scrap, merely specifying that no large pieces shall be included. The following specification covers this point :—

SPECIFICATIONS FOR MACHINERY SERAP.

Under this specification is desired a good clean scrap-iron, such as agricultural implements and light machinery scrap. The scrap must contain no wrought-iron, steel, stove plate, grate bars, car wheels, brake shoes, chilled roll, &c. Malleable scrap is objectionable, also an excess of rusty iron. Large pieces, weighing more than 400 lbs., will not be accepted. When a car of scrap is received, the inspector will superintend the unloading and discard the following objectionable materials, viz.: Wrought-iron pieces, steel, burnt stove plate, grate bars, car wheels, brake shoes, large chilled work, burnt malleables, and large pieces weighing more than 400 lbs. Rejected scrap will be deducted from the total weight of scrap received, and payment made only on accepted material.

2. Heavy Machinery Scrap

As the name implies, this scrap will consist of large pieces from fly-wheels, engine beds, large pumps, blowing machinery, mining machinery, gears, cast die blocks, mill castings, &c. The pieces may weigh several tons, or may be broken into small pieces; in any event the pieces will naturally be large and heavy, and consequently too large for the ordinary cupola. The breaking of heavy castings is a serious problem, and not only involves an extra amount of work, but adds to the expense. The average analysis will usually be found within the following limits :—

Silicon	1·60 to 2·20	per cent.
Sulphur	·075 to ·150	,,
Phosphorus ...	·40 to ·80	,,
Manganese ...	·30 to ·90	,,
Total carbon ...	2·75 to 4·00	,,

Heavy scrap is generally used for heavy work, and should be melted in a large cupola. The amount varies from 20 to 60 per cent., but should not exceed 50 per cent. if the iron is mixed by analysis and the castings are to be made by specification. Where the resultant castings are not made under specification, any amount may be used, providing enough silicon be present to insure a fairly soft iron for machining. Specifications for heavy scrap are worded as follows, viz. :—

SPECIFICATIONS FOR HEAVY CAST SCRAP.

Material purchased under this specification is understood to belong to the class of cast-iron known as "heavy scrap," consisting of bed plates, gears, wheels, supports, engine parts, cast pipe, heavy machinery, &c. The following material is objectionable, and will not be accepted, viz.: Burnt annealing pots, burnt furnace castings, wrought-iron or steel shafts, steel plate, sheet iron, galvanising iron, &c. Such material will be thrown aside, and payment made only on the accepted scrap.

3. *Stove Plate Scrap.*

New stove plate is considered as an excellent soft scrap on account of the high silicon, graphite, and phosphorus content. Old stove plate, containing burnt iron and an unlimited amount of rust, is objectionable, and many foundrymen will not use it at all. Old stoves and furnace castings which have been in use for years, are generally pretty well "burnt," and consequently are high in sulphur and low in graphite. New stove plate is scarce and high in price, while old stove plate is cheap; therefore, very little of the former article is found in the scrap now on the market. No specifications calling for *new* stove plate scrap would be effective, as it is almost impossible to get such a grade. The only specification that we know of makes no such distinction, but deals with the ordinary mixed scrap in the following manner:—

SPECIFICATIONS FOR STOVE PLATE SCRAP.

The scrap purchased under this specification is assumed to be a soft cast-iron consisting mostly of *broken* parts of stoves and furnace castings. An admixture of light machinery scrap is permissible, but parts of stoves from the fire box are objectionable, also pieces which are badly warped or burnt. On receipt of a shipment or load of stove plate scrap the material will be sorted and the "objectionable" material laid aside. The purchaser retains the right to reject such material or to accept it at a reduced price, providing it may be made into grate bars, sash weight, &c. It is distinctly understood that this latter clause be optional with the purchasing agent. It will be seen from the above specification that there is a serious objection to burnt iron, yet there is a desire to keep such poor material providing the price is right, and we are inclined to think that all of the burnt iron is not made into sash weight. Taking the average run of stove plate scrap, including a small amount of fire box parts and other objectionable pieces, the material will generally analyse within the following limits:—

Silicon	2·30	to 3·30	per cent.
Sulphur	·075	to ·135	„
Phosphorus ...	·45	to 1·25	„
Manganese ...	·20	to ·70	„
Total carbon...	3·50	to 4·50	„

There is a wide variation in the above, but it must be remembered that there is a vast differrence in the composition of new and old stove plate scrap; furthermore that one founder believes in high phosphorus and silicon, whereas another might think the desired fluidity could be obtained with a high carbon and silicon; both, however, adhere to the high silicon idea. High phosphoric iron is easily fusible, while high graphite iron is the reverse, consequently the latter mixture is now favoured. The following analysis of new stove plate and the same material after two years' usage illustrates the difference in composition:—

	New Material.	Old Material.	
Silicon	2·60	2·52	per cent.
Sulphur... ...	·089	·117	„
Phosphorus ...	·720	·731	„
Manganese ...	·30	·21	„
Combined carbon	·20	·42	„
Graphite carbon	4·00	3·56	„

The piece in question was said to be part of the fire box, and the claim is made that the great increase in sulphur was due to the absorption of sulphur from the coal; evidently, it must have been a poor grade of soft coal.

4. *Car Wheel and Chilled Iron Scrap.*

Car wheel scrap is a very desirable material for strong and hard cast-iron mixtures. The only objection to this class of scrap for use in the ordinary foundry is in the size of the pieces and the labour required to break the wheels into sufficiently small pieces. A 1,000 pound weight dropping 10 ft. is hardly sufficient to reduce the large wheels to proper size, consequently repeated blows are required and much time consumed.

A larger weight or higher drop is more effective, but very few foundries are supplied with the proper apparatus. For large work, and with a large cupola, the trouble is not so great. "Car wheel scrap" is considered a superior grade of cast-iron on account of the low phosphorus content and consequent strength. The following specification gives a good idea as to the quality of cast-iron which may be included in this class:—

SPECIFICATIONS FOR CAR WHEEL AND HARD IRON SCRAP.

The following materials will be accepted under this specification, viz.: Cast-iron wheel; chilled iron rolls, gears, grinders, &c.; semi-steel castings; cast-iron gun metal; steam cylinders, &c. Brake shoes, malleable iron, car scrap, journal boxes, &c., are not desired. Steel castings and die blocks are also objectionable unless especially specified. All undesirable material will be sorted out, and may be rejected or retained if found to be in accordance with our specifications for such other class of scrap. The sorting of material will be superintended by the inspector, and payment made in accordance with the class of scrap received. Specifications for scrap iron are liable to be drawn too rigid, but the desire to obtain a class of scrap suitable for certain specified purposes is an excuse which must not be overlooked.

Car wheel and hard iron scrap, although very desirable for certain classes of work, must be used with caution in ordinary foundry mixtures, as the low phosphorus and silicon have a tendency toward sluggish iron or lack of fluidity. There is quite a variation in the chemical composition of car wheels, chilled rolls, semi-steel, &c., belonging to this class of scrap, but the following limits will be of close approximation:—

Silicon... ...	·50	to 1·75	per cent.
Sulphur ...	·075	to ·150	„
Phosphorus...	·30	to ·65	„
Manganese ...	·30	to ·90	„
Total carbon	2·00	to 3·75	„

If semi-steel were not included in this class the average analysis would correspond closely with that of a good cast-iron car wheel mixture.

5. *Cast-Iron Borings.*

Cast borings can hardly be considered as a legitimate scrap iron, and, as a rule, are not desired by the foundrymen. On acconnt of the fineness of the particles, much of the iron is lost in melting either by being burned up or oxidised, or uniting with the slag. In some cases the loss exceeds 30 per cent., and under the most favourable conditions is seldom less than 10 per cent. Numerous methods have been tried in melting borings, one of which is to inclose them in strong pine-boxes and charge in the cupola along with the pig-iron. Another method is to inclose them in sheet-iron boxes, but this is somewhat expensive, and not very satisfactory. Borings made into briquettes with pitch are not a success, as the binder melts too easily. Briquetted with lime, salt, cement, &c., this defect is overcome, but other objectionable features are presented, in which the excess of rust, due to the water introduced, is a serious objection. The amount of metallic iron in a good cement bound briquette seldom exceeds 80 per cent.; if, however, we include the graphite, manganese, &c., the total considered as pig-iron would not exceed 88 per cent., thus leaving at least 12 per cent. of residue which goes into the slag. The amount of binder or cement is usually about 5 per cent., while the remaining 7 per cent. consists of iron oxide, water, dust, &c. Briquettes have been made with more iron than above stated, but actual experience has proven that the regular run of such material is similar to the above figures. Good results are obtained by melting 12 to 20 per cent. of briquetted borings with regular scrap and pig-iron. Briquettes melted alone produce an excess of slag and bung up a cupola so that it is almost impossible to draw off the iron.

The ideal method of melting borings is

by means of an air furnace or the open-hearth furnace, in which event the iron takes up very little sulphur, although there is quite a loss from oxidation. Borings melted in a cupola (using the material packed in wooden boxes) is as good a method as any yet devised in general foundry practice, but there is considerable loss or waste, and a large increase in the sulphur content. Borings showing an analysis ·085 per cent. of sulphur, melted with foundry coke (containing ·80 per cent. of sulphur), will produce an iron containing ·120 per cent. of sulphur. Borings mixed with tap cinder and ore produce an inferior quality of pig-iron; fortunately there is very little of it on the market.

The only specification we know of for this class of material reads as follows:—

SPECIFICATIONS FOR CAST-IRON, STEEL AND WROUGHT BORINGS.

In making contracts for borings it is stipulated that the manufacturer, machine shop, or iron mill superintendent see to it that the different kind of borings, punchings, &c., be stored in proper bins and covered in such manner as to exclude rain and snow. Separate bins must be provided for cast-iron borings; steel borings, punchings, &c.; and for wrought-iron borings. In case the borings are mixed a reduction in price previously agreed upon will be made. Borings freed from oil by means of a centrifugal machine or similar device will be paid for at the price affixed in the contract. In the above specification the last clause relating to oil seems rather superfluous, as most manufacturers consider the oil more valuable than the borings and endeavour to save it. The average analysis of the three different kinds of borings may be approximated quite closely, but the variation is necessarily great.

Variable analysis of cast-iron borings:—

Silicon	1·50	to 3·00	per cent.
Sulphur	·075	to ·165	,,
Phosphorus	·30	to 1·25	,,
Manganese	·20	to ·90	,,
Total carbon	2·50	to 4·50	,,

Variable analysis of steel borings:—

Silicon	·00	to ·50	per cent.
Sulphur	·015	to ·095	,,
Phosphorus	·015	to ·18	,,
Manganese	·10	to 1·00	,,
Combined carbon	·10	to 1·50	,,

Variable analysis of wrought-iron borings:—

Silicon	·00	to ·15	per cent.
Sulphur	·008	to ·045	,,
Phosphorus	·011	to ·35	,,
Manganese	·00	to ·15	,,
Carbon	·00	to ·10	,,

6. *Malleable Iron Scrap.*

There is very little call for malleable iron scrap among the grey iron founders, and the malleable iron men are somewhat adverse to using anything except that which they are familiar with, especially in the annealed form. White iron is not to be had, as the malleable iron founder can use all the sprue he can make, providing it is of good quality, otherwise some of it may occasionally be found on the market. Saddlery hardware is generally a pretty good class of scrap, but it is so small in size that there is never a great accumulation. Burnt annealing pots, over annealed iron, burnt sprue, &c., is an objectionable class of material, but it is frequently used for sash weights, grate bars, &c. The loss in melting burnt iron, scale, and rust is, however, so great, and the resultant casting so poor, that it is a question if such work pays. We know of no printed specification for malleable scrap, but nearly every class of scrap, from light machinery to car wheel generally, contains various amounts of malleable iron castings either large or small, and it is simply impossible to make a fine distinction in the matter. A reasonable amount of malleable iron in grey iron scrap is seldom objected to. The malleable iron man claims that there is very little malleable iron on the market, as such material never breaks.

The average limits of a malleable iron analysis will be as follows :—

Silicon	·30	to 1·75	per cent.
Sulphur... ...	·035	to ·095	,,
Phosphorus ...	·011	to ·22	,,
Manganese ...	·15	to ·50	,,
Total carbon	1·85	to 4·25	,,

If the total carbon is low, the indications are that steel has been used in the mix, or that the material has been long annealed. Malleable scrap is not liked by the grey iron founder on account of the low phosphorus and low silicon, both of which reduce the fluidity of molten iron. In grey iron castings it is desirable to use an iron containing not less than ·30 per cent. of phosphorus, and for light castings ·70 per cent. is preferable. In malleable iron mixtures it must not exceed ·22 per cent., in fact a low phosphorus is desired.

7. *Steel Scrap.*

Steel scrap is coming into use more and more every day, and is in great demand. It used to be considered an impossibility to melt steel in the cupola and have it mix with the cast-iron, but nowadays it is common practice, and many foundries are melting from 10 to 40 per cent. of steel scrap. With a little experience in charging, regulating the blast, fuel, &c., perfect mixtures may be obtained. The object in using steel scrap is to reduce the amount of graphitic carbon (in reality it actually reduces the total carbon to a certain extent), thereby producing a hard, strong, close-grained iron. Steel scrap is seldom used in soft iron mixtures unless there be danger of "kish," in which event 50 lbs. of steel to a ton of iron is sufficient to overcome the difficulty. With 30 per cent. of steel, 15 to 20 per cent. of home scrap, and the balance pig-iron, estimated so that the resultant castings contain 1·50 to 1·75 per. cent. silicon, sulphur not over ·075, manganese about ·50 or ·60, and phosphorus at ·40 to ·50 per cent. the iron will have a tensile strength of 35,000 to 40,000 lbs. per square inch, and the transverse strength on a 1 in. square bar, 12 in. between supports, will be between 3,600 and 4,500 lbs. In charging steel scrap in the cupola it must be borne in mind that no small pieces be used, as such pieces seldom melt, consequently mix with the iron and produce hard spots. Steel rail cut into 16-24 in. lengths are considered the best scrap. The following specification covers the size and other desired points :—

Specifications for Steel Scrap.

Under this specification no distinction will be made between open-hearth or Bessemer steel; the main point considered will be in regard to size and general composition. It may be optional with the purchasing agent to order steel rail, steel castings, clippings, or mixed steel scrap. In ordering steel rail it is understood that the pieces are to be cut to a length of not less than 12 in. or longer than 24 in. (16 to 18 in. lengths preferred). In the event of steel castings being ordered, we reserve the right to reject all small pieces, *i.e.*, less than 6 in. in diameter, and extremely large pieces weighing more than 500 lbs. When mixed steel scrap is ordered it is distinctly understood that no small pieces will be accepted, the smallest size being limited to 6 in. in length or diameter in flats, sheet punchings, clippings, &c.

No borings or shavings will be accepted. Mixed steel scrap may include—steel shafting, boiler plate, structural steel, springs, cutlery steel, tool steel, cast steel, rail, machinery steel, &c. Steel scrap will be divided into the three following classes, viz.: (A) Rail steel, (B) Steel castings, (C) Mixed steel scrap. The purchasing agent will order the material according to this code, and the inspector will see that the shipment is sorted according to class. Payment will be made on this basis only. It will be noticed from the above that the preference is for rail steel. In regard to the other two grades, *i.e.*, steel castings and mixed

steel scrap, there is a difference of opinion as to which is the best; some prefer the cast steel, while others like the mixed scrap. The following analysis gives a good idea as to the composition:—

Limit analysis of rail steel:—

Silicon...	·04	to	·50 per cent.
Sulphur	·025	to	·125 ,,
Phosphorus ...	·05	to	·14 ,,
Manganese... ...	·18	to	1·50 ,,
Combined carbon	·20	to	·80 ,,

Limit analysis of steel castings:—

Silicon	·02	to	·50 per cent.
Sulphur... ...	·012	to	·065 ,,
Phosphorus ...	·02	to	·12 ,,
Manganese ...	·20	to	·80 ,,
Carbon	·50	to	·90 ,,

Limit analysis of mixed steel scrap:—

Silicon... ...	·00	to	·75 per cent.
Sulphur ...	·005	to	·125 ,,
Phosphorus	·005	to	·25 ,,
Manganese...	·10	to	1·50 ,,
Carbon ...	·10	to	1·50 ,,

The great variation in mixed scrap may be accounted for from the fact that this class of material may contain a mild steel with .10 per cent. of carbon or a die block of tool steel with 1·50 per cent. of carbon. Tungsten, chromium, molybdenum, &c., used in self-hardening steels, is not considered in the above analysis, as the percentage of tool steel in scrap is extremely small. The rapid cutting tool steels, which are usually hardened in a blast of air, belong to this class and contain from 1 to 20 per cent. of tungsten, with from ·25 to 4·50 per cent. of chromium.

Unless the tool steel is burnt or otherwise damaged, it would be folly to consign such material to the scrap heap. An unfinished die found in the scrap heap was analysed out of curiosity and found to be a superior grade of "high speed" tool steel. The tool maker evidently did not know how to work the metal and probably condemned it as being no good.

The analysis was as follows:—

Silicon	·22	per cent.
Sulphur	·011	,,
Phosphorus ...	·011	,,
Manganese... ...	·12	,,
Carbon	·52	,,
Tungsten	18·00	,,
Chromium	3·30	,,

In the analysis of the different kinds of scrap the aim has been to include the variation of extremes, consequently for practical purposes it is customary to add the two extremes and divide by two for an average, thus: The variation in sulphur being ·025 to ·125, the average would be ·075 per cent., which is close enough for estimating the first mixtures when starting out with a change of scrap.

8. *Wrought-Iron Scrap.*

There is very little call for this class of scrap. It is used in a limited way in the manufacture of Metis Metal, which once was in demand, but has since been forced aside by the modern steel castings. The high melting point of wrought-iron excludes its use in the cupola, although some foundrymen still use a small amount (20 lbs. wrought-iron to 2,000 lbs. of pig) to prevent "kish." Steel scrap answers just as well, and is more easily melted. The following specification defines the use of wrought-iron in the manufacture of re-rolled or commercial refined iron:—

Specifications for Wrought Scrap.

The following material will be accepted, viz.: Wrought-iron rods, shafts, girders, beams, heavy hoop irons, horse shoes, heavy iron wire, spikes, wrought nails, rivets, bolts, flat wrought bars, and other wrought-iron material excepting borings, tacks, nuts, washers, &c. Steel is not desired, but the material will not be rejected on account of a small amount of steel welded or fastened to the wrought pieces. Rounds, flats, horse shoes, large rivets, heavy wire, &c., are preferred. Scrap containing washers in quantity or

other small pieces, will be accepted only at a reduced price.

General analysis of wrought scrap :—

Silicon ...	...	·008 to ·15	per cent.
Sulphur...	...	·008 to ·045	,,
Phosphorus ...		·011 to ·35	,,
Manganese ...		·00 to ·10	,,
Carbon ...	...	·00 to ·05	,,
Graphite	...	·01 to 1·20	,,

An ideal wrought iron should be low in everything but pure metallic iron. With manganese or carbon above ·10 per cent. it inclines to becomes steely; sulphur makes it red short, and most specifications limit this element to ·04 per cent. Phosphorus should be below ·10 per cent. carbon, the lower the better; graphite is objectionable, and an excess of slag shows that the iron has not been sufficiently worked. The re-rolled or commercial refined iron made from scrap always contains more or less steel, consequently such iron is higher in manganese, carbon, and sulphur, than the regular puddled wrought iron. This material generally has a high tensile strength, but the fibre is poor; it is, therefore, unsuitable for stay bolts, rivets, &c.

9. *Mixed Scrap.*

This class of scrap may contain "any old thing" from tin cans to anvils or cannon. Such material is usually collected by junk dealers and sorted into the following material: Cast-iron, wrought-iron, sheet-iron, brass and bronze, tin-ware, lead and similar metals; also steel, providing the junk dealer is able to distinguish it from iron. The tin is reclaimed from the cans and the remaining iron used for making copperas, melting into sash-weights, &c. The lead and brass goes to the bearing metal or Babbitt maker, while the iron is generally sold to the foundry. Much of this iron scrap is good, but as a rule it is poorly sorted and consequently contains considerable wrought-iron.

10. *General Remarks on Scrap Iron.*

At present no fine distinction is made in regard to the classification of scrap by the jobbing Foundry, but the large manufacturers are more particular and insist on some form of sorting. Evidently the tendency is along this line and will eventually result in the scrap being carefully sorted by the scrap dealer, resulting, of course, in a scale of prices, according to grade.

Every foundryman is inclined to use scrap, preferring it to grey forge at the same price. As a rule a mixture containing scrap produces a stronger cast-iron than an all-pig mix. There are several reasons for this, one of which is that the graphitic carbon is in a finer state of division than in pig-iron. Another idea is that the total carbon is reduced by addition of scrap, which acts like steel in this respect. Steel being free from silicon and graphite, not only reduces the silicon and total carbon in the cupola mixture, but actually favours combined carbon.

If a mixture be made from pig-iron only, with, say, a silicon content of 1·80 per cent., all other metalloids being normal; and another mixture be made of pig, with, say, 15 per cent. of steel, the resultant cast-iron containing 1·80 per cent. of silicon and identically the same amount of total carbon, &c., it will be found that the steel mixture will be the stronger, and if heat conditions could be absolutely controlled the combined carbon would be higher. This experiment has been tried several times, and even with the same carbon ratio the steel mix was the stronger iron. This state of affairs may possibly be solved by means of the microscope, hence the "fineness of division" theory will then be made clear. The claim is also made that the difference in strength and closeness of grain in castings made from charcoal and coke pig-iron is due to the finely divided form of the graphite in the former pig-iron. No matter what the cause, or what theory be accepted, the fact remains that an iron containing scrap will be stronger than an all-pig mix. The whole secret of strength in cast-iron is conceded to be due to

carbon, and is dependent upon the ratio of the two forms—*i.e.*, combined and graphitic. Furthermore, this ratio is greatly influenced by the amount of total carbon within certain limits, for example: A sample of cast iron containing 3·50 per cent. of graphite or graphitic carbon, and ·50 per cent. of combined, will not have a strength equal to one containing 2·80 per cent. of graphite and ·40 per cent. of combined carbon, although each one bears the ratio of 1 to 7. This is easy of solution, for the reason that graphite has no strength of its own, and any excess present simply reduces an equivalent percentage of metallic iron. In the case cited there was a difference of ·70 per cent. Taking 34,750 lbs. as the actual tensile strength per square inch of pure metallic iron, ·70 per cent. of graphite would make a difference of about 243 lbs. When, however, we go to extremes, and reduoe the total carbon to a minimum, the result is a hard, brittle iron. On the other hand, an excess of carbon, especially graphitic, produces a soft, weak iron. Repeated melting will reduce both the silicon and the carbon, and eventually result in a white iron. Scrap-iron, having been melted once or more times, is, therefore, started on this course, and would eventually reach the white iron stage if remelted a sufficient number of times. The regular foundry re-melt, known as "home scrap," is preferable to a "foreign scrap," as its composition is known, and the re-melting has not been carried too far. Good castings with a high strength may be made from an all-scrap mix, providing a little ferro-manganese be added as a cleanser, and sufficient ferro-silicon charged to make the iron soft enough to machine. Making an all-scrap mix by analysis is difficult, but it is being done every day, and the results are said to be satisfactory.

In conclusion, we pray that the "scrap heap" may be more respected in the future, its value recognised, and the good separated from the bad.

THE EXTRACTION OF RARE OR REFRACTORY METALS.

Alkaline Metals.

As is well-known in the Foundry world, there is a class of metals which do not come within the ordinary processes of metallurgy, these being those which chemists classify in the first sections and which are characterised by their great affinity for oxygen, viz., alkaline metals, such as potassium or sodium; alkaline-earthy metals, as magnesium and calcium; and earthy metals, as aluminium.

Strata.—These metals form the essential base of most terrestrial rocks, being there found in the form of oxides combined with silica, as alumina in clays, and with carbonic acid, as lime in limestone. They are therefore found in soil in far greater quantities than usual metals, but they have received as yet but few applications, and, from an industrial point of view, they may be considered as rare metals. The same cause which explains their great diffusion renders them very difficult of extraction. According to the indications which we are supplied with by geology for the reconstituting the history of the earth, the soil may be considered as an immense crust of scoriæ enveloping an incandescent metallic sphere. During the formation of this scoriæ, which becomes thickened by continual cooling, the lighter and more oxidisable metals are scorified first and come to the surface; but their oxides are more difficult of decomposition than all the others, and the date is not very remote when their true nature was unknown, and when it was not known that the commonest of soils contained veritable metals.

Chemical Processes.

A few brief particulars in regard hereto (for which we are indebted to "La Métallurgie," as also for the remainder of this article) may not be without interest to our readers, showing as they do the methods adopted in France.

Reduction of Alkaline Oxides.—The reduction of these oxides by coal is not, properly speaking, impossible, as has often been maintained, though a deal of difficulty is experienced in collecting the products from it. A phenomenon happens similar to that which gives rise to the formation of zinc oxides in blast furnaces. In blast furnaces the zinc is reduced, but it reoxidises almost immediately, depositing in the form of white dust at the furnace mouth; just the same when an alkali is heated by coal, at first a reduction is effected, but scarcely is the metal free than it reoxidises upon contact with air, carbonic acid, or steam. Moreover, this reoxidisation is so rapid that it cannot be averted. In view of this, therefore, it might almost be said that the reduction is but momentary, being effected one moment, and the next it reverts to its former condition.

In order to collect the metal, it should be immediately kept from all oxidising action, and should not be left in the furnace in contact with the scoriæ. The alkaline metals—such as potassium and sodium—are the first to be isolated, though they should be, as regards chemical affinity, the most difficult to reduce, which is owing to the fact that they are volatile, and that their vapours can be rapidly collected when protected from the air.

Distillation of Sodium.—For some time this has been prepared in small quantities by varying methods by heating the alkaline carbonates mixed with coal in a retort. This retort is supplied with a projecting piece made of flattened iron, through which the vapours escape in the form of thin plates or sheets. The metal collects in a melted state at the bottom of this recipient and runs at once into a reservoir, where it falls under a layer of petroleum. The process and apparatus employed are very similar to those used for reducing zinc ores.

Displacement of Metals by Sodium.—Sodium, by virtue of its great affinity for oxygen and chlorine, has served as a reagent on the preparation of other metals not reduced by coal, thus magnesium and aluminium have been obtained by decomposing, at a red heat temperature, the melted chloride of these metals by sodium, which combines with chlorine and takes the place of the metal which it is desired to reduce, which separates in a liquid form at the bottom of the bath.

It should also be possible for the oxides to be decomposed by sodium, but the reaction is not obtained currently with these, because the oxide is not fusible. It is for this purpose that recourse must be had to chloride.

These processes have always remained very expensive, and most of the metals of this class are not true industrial products. The alkaline metals can only be preserved and handled away from the air, and they are only of interest as reagents for the manufacture of certain chemical products. Magnesium, which is not so changeable, is employed because it burns, when lighted in the air, with a dazzling flame.

(*To be continued.*)

PIG-IRON WARRANT SYSTEM AND THE FOUNDRY.*

By George H. Hull.

THE proposed letting of a contract for a large amount of castings to be used in connection with the Pennsylvania tunnels in New York, deliverable over a period of four years, has for several months been a topic of much discussion among iron foundrymen, and the would-be contractors have found embarrassment over the question of how to protect themselves in making a bid at a fixed price, and for fixed dates of delivery, over so long a period, in face of the well-known irregularities which in the United States attend the supply of pig-iron, both as to

* Read at the Indianapolis Convention, June, 1904, of the American Foundrymen's Association.

price and deliveries. With the experience of the last five years fresh in mind, during which iron advanced to 25 dols. per ton, and the stock held by the merchant furnaces was on two occasions reduced to less than 50,000 tons, the idea of making a contract for 300,000 tons of castings with fixed dates of delivery seemed like tempting fate.

If, for example, the furnacemen with whom the foundryman made his contract for pig-iron should, for any reason beyond his control, be unable to make or deliver the iron at dates specified, and iron should again be scarce and high, it is impossible to tell how serious the result might be. The custom prevalent among foundrymen in the United States of taking contracts for castings, deliverable on fixed dates, over long periods, and of relying for their materials upon a contract with iron producers, containing what is called the strike or accident clause, reading: "Shipments and deliveries are subject to strikes, accidents, deficient transportation, and all other causes beyond our control," seem to the mind of the Scotch foundryman to voluntarily invite disaster. The possibility of a strike in his own works he recognises as a risk of his own, and one which he cannot avoid, but the idea of doing business on the basis of assuming everybody else's risk, all down the line, he does not comprehend.

If the foundryman allows the strike or accident clause to be inserted in his contract for pig-iron, ordinary prudence would prompt him to require the same in his contract for castings, and so must each one all along the chain of producers and consumers. Through such a custom anyone may escape the obligation of making deliveries on time, either through a difficulty at his own works or an interruption in the delivery of his raw materials. When such a condition has become general (and we are drifting rapidly toward it), a labour leader in any one branch of the industries may control all the productive industries of the country. A steamship in progress of building, for instance, would progress toward completion only when labour in all the trades which furnished any material for that steamship graciously permitted it to do so. Labour leaders already have power enough, without any such voluntary aid from employers. Fortunately, it is often impossible for the labour leaders in one trade to induce other trades to join in a sympathetic strike, but just to the extent that employers accept this strike or accident clause, they hand themselves over, "bound hand and foot," to the mercies of the labour leaders of every trade which is in any way connected with their own.

But this is not the only evil encouraged by this strike or accident clause. It is probably the most potent means which could possibly be devised for discouraging the accumulation of reserve stocks of raw materials. If the sellers of pig-iron, for instance, were not permitted to embody this conditional clause in their contracts—that is, if the consumer would accept only contracts for iron which required positive delivery at times specified—then the sellers, through ordinary prudence, would be forced to carry a reserve stock sufficient to enable them to make deliveries through any ordinary period of interruptions which might take place in their works; and these reserve stocks, if thus accumulated in every branch of manufacture, would not only be a great boon to all the constructive industries of the country, but they would go far toward discouraging labour strikes within these industries.

The Hon. Carroll D. Wright, United States Commissioner of Labour, when he visited New York in the winter of 1903 as the representative of President Roosevelt, to investigate the anthracite coal strike said to an enthusiastic exponent of the reserve stock system that if the coal operators in the United States had carried out his theory of accumulating large reserve stocks of coal, there would probably have been no strike. In determining whether to strike or not to strike, the

labour organisation will first consider its chances of success. In whatever branch of production the strike is contemplated, success depends largely upon the reserve supply of the product immediately involved. If the stock be small, the necessities of the community go a long way towards forcing the producers to resume work, even to the point of conceding to unreasonable labour demands. On the other hand, if the stock is large, that one fact will almost certainly prevent a strike, unless it is founded on some good and sufficient reason.

In this country, under existing conditions, the only way a foundryman can make a contract for a large amount of castings, deliverable over a long period, and be sure of having the required amount of pig-iron when he needs it, is to buy it out and out, and pile it in his yard at the time he makes the contract. But this would tie up an unreasonable amount of capital, and occupy too much of the consumer's yard space. The producer, on the other hand, has no incentive to accumulate iron; he may contract his anticipated product for months ahead, deliver it on those contracts as made, and if anything beyond his control prevents his producing it, he is relieved from delivery by the strike or accident clause. He may sell his expected output a year ahead if he chooses, and not be obliged to carry a single ton of stock. What is the result? No one carries any stock which he can avoid, and when each period of prosperity returns to the country the whole fabric of business is hampered, delayed, and disorganised by the famine in iron; prices soar to fabulous heights, all other materials follow in sympathy, labourers strike all the way up to get their share of the good times, and afterward, all the way down to ward off their share of the bad times. Eight times within the last eighty years this country has suffered from an iron famine. Everyone who had work which required iron was behind, and the whole business of the country was delayed in consequence of the scarcity of this one article.

If you think I am giving too much importance to iron, remember it is the foundation of all the mechanical industries. Look about you, out of doors or in. Can you see any article of value produced by man which is not fashioned with the aid of iron? The food you eat is cooked in iron utensils; the clothing you wear is woven by iron machinery; it is necessary to every step of man's progress. If you double the mechanical industries, you double the wear and tear of iron and the demand for it. Remove iron, and you paralyse the commerce and industries of the civilised world. Is it too much to say, then, that a famine in its supply, and an advance of 100 to 300 per cent. in its cost, will derange and retard the industries of which it is the foundation? There is no other staple which cannot be supplied quickly enough to meet a suddenly increased demand of 100 per cent. To meet a corresponding increase in the demand for iron is impossible. It therefore becomes evident that these abnormal and injurious advances can be modified only by producing in dull times a surplus stock as a reserve to supply the demand in active times. It is no more over-production to accumulate, during seven or eight years of dulness, enough iron to supply the demand during the succeeding two or three years of activity, than it is to accumulate during the three months of harvest enough grain to supply the demand during the succeeding nine months. It only requires that the mind shall become accustomed to the idea to fully accept it.

For several years previous to 1897 the production of iron in this country was on the plane of about 9,000,000 tons per annum; iron producers were bemoaning what they called over-production, and furnaces were often banked to curtail production, although the reserve stock was only 500,000 to 1,000,000 tons. Since that time events have shown that if the

reserve stock had been 37,000,000 tons, and the furnaces had continued to produce 9,000,000 tons per annum, it would by this time all have gone into consumption. Think of the absurdity of crying over-production, with but 1,000,000 tons of iron in stock, on the eve of a period of prosperity which required an additional supply of 37,000,000! Is it any wonder that the stock during the last six years has often been down to less than a day's product, and that the iron consumers suffered?

If the consumers of this country are in the future to be protected as to their supply of iron, they must protect themselves as is done in Scotland. They cannot expect the producers to do it for them. If the producers sell them iron deliverable six or twelve months ahead, they must either protect themselves by storing the iron, or demand a contract with the strike and accident clause. No prudent furnaceman would do otherwise, and yet to continue the present custom is to ensure a continuance of the known evils of the past.

A contract with the strike or accident clause is worse than no contract at all. It is a promise with an "if." When the "if" is not called up, you would do as well without the contract as with it. When the "if" is called up, you are left in a tight place, with no one under obligation to help you out. Without such a contract you would probably have bought and piled up the iron to protect yourself. Of all the delusions and snares which attend the business systems of this country, I know of none in appearance so harmless, and yet so blighting in effect.

What the foundryman in the United States most needs is a system whereby he can purchase his iron at a fixed price, and far in advance, with the certainty of obtaining it when needed without tying up his working capital; and without piling up a surplus quantity of iron in his own yard. The Scotch warrant system has satisfied this same need in a perfect manner for 50 years, and it is for this reason that it has become the established system of that country.

In Scotland, when a foundryman takes a contract for a large amonnt of work, deliverable over a long term, he goes directly to a warrant dealer and makes a contract for warrants for a corresponding amount and time of delivery; these contracts have no strike or accident clause; they are positive and must be kept, or the seller must suffer the loss entailed. A warrant dealer in Scotland will sell protection to a consumer for five years ahead just as readily as he will for six months or a year. The charge he makes for such protection is based on what it will cost him to buy iron by warrant the day he makes the contract, and carry same to the dates of deliveries called for by the contract. When the warrant dealer enters into a contract to protect a consumer in this manner, he must necessarily buy warrants to protect himself, and as long as the contract of protection runs, he must own and carry warrants to protect himself. By this system the capital and space necessary for perfect protection to the consumer is provided at a reasonable cost and without his depriving his business of either capital or yard space required. The establishment of the warrant system was as great a relief to the iron producers and consumers of Great Britain as was the establishment of the national banking system to the financial exigencies of the United States. One created a demand for bonds which had never before existed, the other created a demand for iron which had never before existed; one necessitated the carriage of bonds by every national bank, the other necessitated the carriage of iron by every warrant dealer. It is through this necessity for carrying a reserve stock that Scotland accumulated six to twelve months' supply of iron, while the United States accumulates but three to six weeks' supply.

How are the American foundrymen to bring about in this country the conditions

existing in Scotland? I presume Americans will have to bring it about substantially just as the Scotchmen did; that is they will, in the beginning, have to buy and carry warrants as a reserve stock, until the business of selling protective contracts becomes an established business among iron dealers. To begin with, we have already in existence the American warrant. This warrant is simply a negotiable warehouse receipt for pig-iron, which describes the brand and quality of the iron, as well as the location of the yard in which it is stored. Warrant iron is graded either by analysis or fracture: when by analysis, it is according to the rules adopted by the American Foundrymen's Association and the American Society for Testing Materials. Each warrant is for 100 tons of 2,240 lbs., and the warrant company is reponsible for the brand, grade, and weight described on its face. Every warrant is registered by a trust company of high standing, and no iron can be delivered from warrant yards without the signature of the trust company, and the president and secretary of the warrant company. Money can be borrowed upon them in every large city in the United States, Canada, and Great Britain.

In Scotland, at the start, foundrymen who made large contracts for work, bought and carried warrants to protect themselves. By this means they held a reserve supply which was always available in an emergency. Firms of large responsibility found it easy to carry these warrants in bank, but it was not so easy for the small and less responsible ones who needed the protection just as much as the large ones. Through this condition iron dealers commenced to make future delivery contracts for warrants with consumers. When the dealers entered into these contracts to protect the consumer they bought iron warrants to protect themselves. This business proved so acceptable to all parties that it grew rapidly, and soon resulted in large carriage of warrants. Thus the system came into existeuce in Scotland in a natural way.

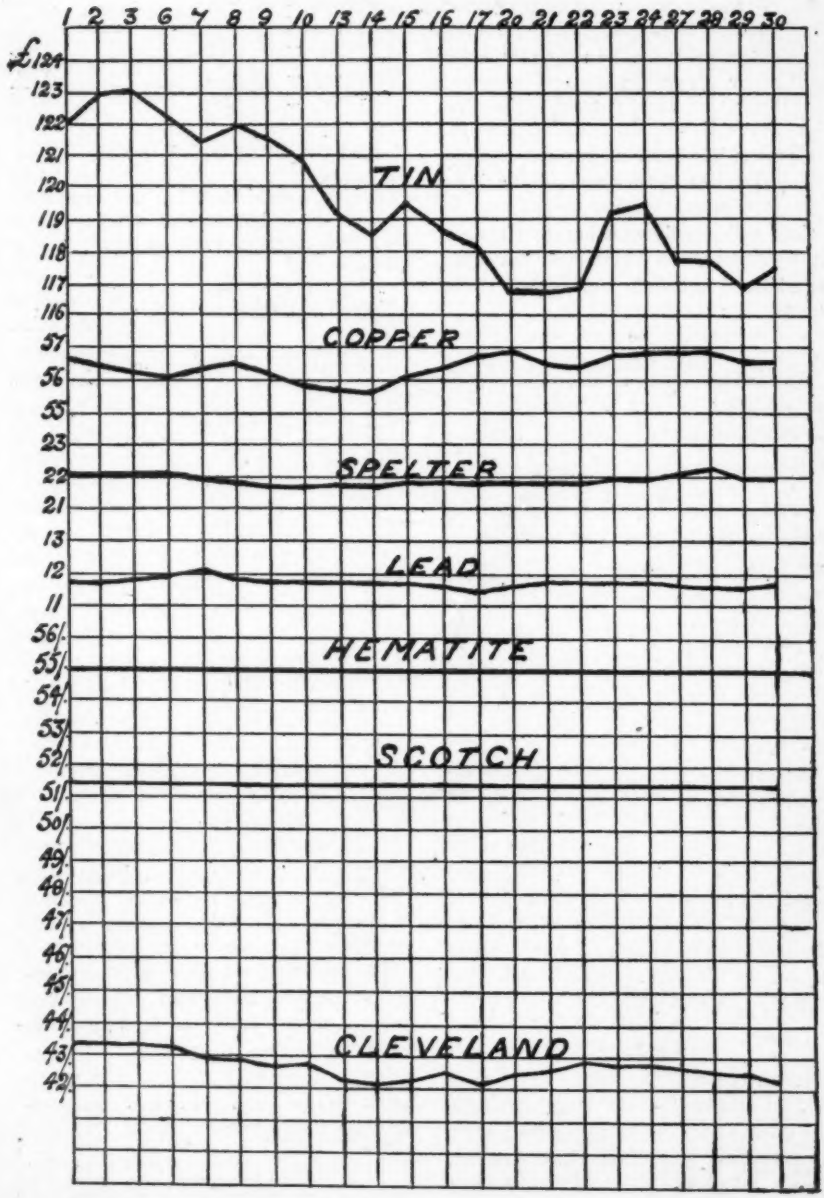
If the foundrymen of this country would introduce the Scotch system and thus obtain certainty instead of uncertainty in their iron supply, they have only to refuse to accept contracts with the strike or accident clause, and if in the beginning they cannot procure binding contracts, then buy and carry warrants themselves as a reserve. Just as soon as the sellers realise that the consumers will buy only by positive contracts, they will be ready to sell them in that way. When this is done, however, the consumers must recognise the fact that whosoever sells the positive contracts takes a risk, and is giving the consumers a protection which is of value, and for which they must be willing to pay a reasonable amount, just as they do for marine or fire insurance. The little they pay for it will be returned ten-fold in time.

There is an impression among many that in Great Britain consumers purchase the iron they consume by warrant. This is a mistake. Consumers there buy nearly all the iron they use from the makers or their agents, precisely as they do in this country. The warrants which the consumers contract for as protection are to them nothing more than protection.

As the months roll by, they purchase the iron or steel they wish for their work of the brand, quality, and shape they require, from whosoever will make the most satisfactory terms, and simultaneously sell on exchange an equal quantity of warrants. If iron has gone up, say, 20s., they pay that much more for their material, and get about that much more for their warrants. If iron has gone down, say, 20s., they buy their material for that much less, and get about that much less for their warrants. In this manner they eliminate every speculative element from their business, and thus insure their legitimate business profits.

(*To be continued.*)

CHART OF THE FLUCTUATIONS OF THE METAL MARKET IN JUNE.



METAL MARKET REPORT.

LONDON, June 30th.

TIN.—This metal has had a most irregular market during the month, and at times exhibited much weakness. Closing price on the 1st £122 2s. 6d.; on the 30th £117 10s.

* * *

Copper has been in fair demand and the market has been firm. There is no difference in the closing prices on the 1st and 30th, the figure being £56 12s. 6d. on both days, and there were but slight variations recorded throughout the month.

* * *

Spelter has been slacker, and the price has dropped to £22 at which figure it closed on the 1st and 30th.

* * *

Lead remained practically stationery closing on the 1st at £11 15s., and on the 30th at the same figure.

* * *

Pig - Iron.—There is no improvement to record in the pig-iron trade, and small prospect of any at present. Middlesbrough exports to Glasgow have dropped by over 20,000 tons less than last year, and now there is Canada endeavouring to ship to Glasgow her surplus output, which in better times she was able to realise good prices for in the States. Scottish founders, too, have given up making for stock during slack periods, as was their wont. The price of Cleveland iron has fallen from 43s. 4d. on the 1st, to 42s. 4d. on the 30th. Scotch iron idle, price remaining at 51s. 6d.

* * *

Hematite is in a worse plight than ever. Demand is very slack, ore and coke on the rise, and prices easier. West Coast makes 55s.; East Coast 51s. 9d. f.o.b., usual ports.

PUBLIC STORES STOCKS OF PIG-IRON IN TONS

	July 7, 1904.	July 9, 1903.	Decrease.
Connal's at Glasgow	9,560	14,160	4,600
Connal's at Middlesbrough ...	78,980	132,800	53,820
Connal's at Middlesbrough hematite ...	300	300	...
West Coast hematite	14,400	16,000	1,600
Totals ...	105,391	163,260	Net dec. 60,020

* * *

PRICES OF WHOLESALE COMMODITIES

APPROXIMATE prices and position at latest date for which statistics are available, with prices and quantities at the corresponding dates in each of the last two years :—

METALS.	1904.	1903.	1902.
Iron—Scotch pig warrant ton	Nom.	52/3	56/6
—Middlesbro' warrants ton	42/8	46/6	51/5½
—W.C. M/nos Bessemer ton	54/0	59/6	60/1½
—Staffordshire bars, Lond. ... ton	£6 10—£8 10	£7—£7 5	£8—£8 5
—Welsh bars, Wales... ton	£6—£6 5	£6—£6 5	£6—£6 5
—Stock, Scotch, July 14 tons	9,565	13,836	47,710
Copper—Chili bars, GMB ton	57 6/3—57 7/6	£56 10—56 15	£53 1/3—53 2/6
—Stock, Europe and afloat... tons	11,137	15,303	23,219
Tin—English ingots ... ton	£123–£123 10	£124—124 10	£128—128 10
—Straits ton	120 5–120 7/0	122 10–122 15	£128 15—129
—Stock, Ldn, Hlnd. and afloat... tons	9,897	9,700	9,957
Tin plates—Charcoal I.C. ... box	12/6—14/0	13/0—14/0	14/6—16/0
Lead—English pig ton	11 17/6—12 0	£11 15—12 0	11 10–11 12 6
Spelter—Ord. Silesian ton	£22—£22 5	20 15—20 17/6	19 2/6—19 7/6
Quicksilver—(75lb.) bottle	£7 17 6	£8 12/6	£8 15
Antimony—Regulus ton	£26 10—£27	£26 10—£27	£30 10—£31
Coal—Lyons Wallsend, London ton	13/0	15/0	17/0

The following are the shipments of pig-iron from Middlesbrough, according to Messrs. Wm. Jacks & Co., Middlesbrough, July 14th, 1904 :

DESTINATION.	Last Month to 14th.	July to 14th 1904.	July to 14th 1903.	July to 14th 1902.	6m. ended June 30th, 1904.	6m. ended June 30th, 1903.
Scotland ...	11,849	17,274	16,801	18,034	226,912	262,931
England & Wales ...	4,811	5,120	7,762	6,449	55,708	92,222
Foreign.....	18,274	13,728	10,693	19,176	265,704	278,713
Totals ...	34,934	36,122	35,256	43,659	548,324	633,866

NEW INVENTIONS.

List specially compiled for THE FOUNDRY TRADE JOURNAL by MR. GEORGE BARKER, Fellow of the Chartered Institute of Patent Agents, Consulting Engineer and Expert, 77, Colmore Row, BIRMINGHAM.

Telephone No. 1,300. Telegraphic Address—"PATENT, BIRMINGHAM."

APPLICATIONS FOR PATENTS MADE DURING JUNE.

*The manufacture of bimetallic ingots by the compression of liquid steel by wire drawing	H. Harmet	12,000
Improvements in or connected with the renovation of moulders' sand ...	J. W. Towers	12,040
Improvements in apparatus for bending tubes, rods, rails and the like ...	T. C. Camden	12,044
*A new or improved process for treating steel and armour plates	E. Engels	12,098
Improvements in ore concentrating apparatus	J. F. C. Abelspies	12,117
*An improved machine for casting metal under pressure in moulds	C. Vellino	12,183
Improvements in the process of and apparatus for the production o pig-iron by reduction and smelting ...	T. Eskuchen and Georgs-Marien-Bergwerksund Hutton Verein - Aktien - gesellschaft	12,269
Improvements in and relating to apparatus for the extraction of metals from their ores	D. S. S. Steuart	
*Improvements in machines for mixing moulding sand and the like	H. Friedfrichs	12,713
Process for the manufacture of iron ...	E. Fleischer, ...	12,785
*Process of manufacturing link-chains by casting	J. P. Promper	13,191
*Improved process for reducing sulphates of the earthly alkaline earths and sulphates of the alkalies to sulphides, and for reducing metallic oxides to metals	C. Castiglioni & L. Calastratti	13,565
A process for separating certain constituents of subdivided ores and like substances and apparatus therefore...	F. E. Elmore	13,578
Improvements in means for dephosphorising iron ores and concentrates ...	W. Simpkin & J. B. Ballantine	14,214
Improvements in machines for punching sheet metal and the like	C. Whitehead	14,279
Improvements in metal rolling machines	P. Blondell, L. A. Sager, F. Lane, & A. M. Erdman ...	14,353

Applications marked with an asterisk (*) denote complete applications.

This specification **No. 23,909/1903,** describes an invention of Mr. M. Harvey, of Walsall, the subject of which is a self contained portable crucible furnace. Of the drawings appended to the Specification we produce figures 1 and 2, which show the furnace in a general perspective view and a vertical section respectively. Referring to the illustrations, the outer shell 1 of sheet steel is carried by side trunnions 2.3 on the carriage 4. The trunnions 2.3 are situated a little above the centre of gravity of the furnace, and the charge in the crucible so that the normal position of the furnace is vertical with the mouth at the top. Within the outer shell the cylindrical casing 10 of the furnace is fitted, an air space 11 being left all round. The casing 10 is lined with fire-brick 12 which is supported by the bottom 13. Fixed to the bottom 13 is a grid 16, 17, 18, made in three parts, pierced by inlet holes 19, and this grid supports the crucible 15, and also the coke for heating the same. The block 21 on the grid by means of a projection 22 which engages a recess in the base of the crucible prevents the latter from shifting when the furnace is tilted. The upper part of the crucible is kept in place and prevented from moving sideways by blocks 23, the block 23, being held in place by a cover plate 27, and the others by angle brackets 29. Between the blocks 23 are sector like fire-brick blocks 31 which rest on the cover plate 27 and on the top of the crucible. One or more of these cover blocks are removed when charging. Further in the underside of these blocks 31 channels are formed through which the blast escapes. A spout 37 is arranged at the top of the crucible. Near the top of the casing 1 is a blast inlet 38, the blast from which fills the air chamber 11 and passes up through the holes 19 in the bottom plate of the furnace. In the bottom of the outer casing is a large hole closed by a hinged cover 40, arranged so that if the crucible should break the metal will run through the holes 19 and be caught by this cover 40 from whence it could be readily removed. A lever 45 is secured to the trunnion to facilitate turning of the furnace when pouring the metal.

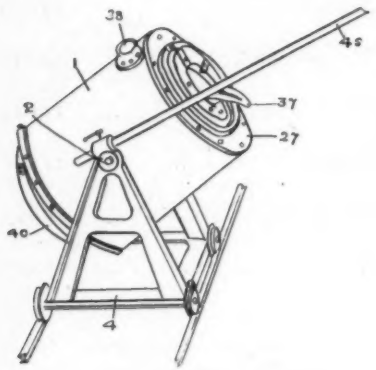


FIG. 1.

PATENT NO. 23,909/1903.

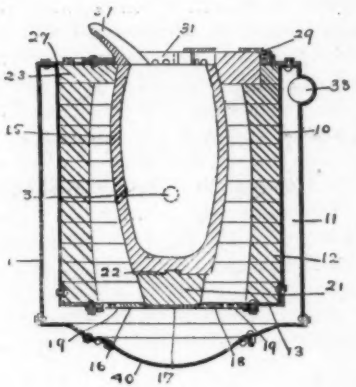


FIG. 2.

PATENT NO. 23,909/1903.

The Index to Vol. V. will be published in the August issue.